The Welding Engineer

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See Page 5

February
1932

PREMIER
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TESTED—BEFORE AND AFTER

in the laboratory before being bundled for shipment and on the job after the welding has been completed. Premier Tested Welding Wires are free flowing, constantly uniform in their structure and deeply penetrating. Free from harmful impurities they provide a weld of maximum strength. The illustrations depict pipe lines welded with Premier Tested Welding Wires. Note how a Premier Weld stands a test for strength.

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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Table of Contents

THE MONTHLY SYMPOSIUM

Hard Surfacing 25
Tanks and Containers 26
Maintenance Welding 27
Production and Fabrication 28
Sheet and Plate Work 29

Will He Get the Job? 31

Aluminum Increases the Pay Load 37
By W. E. Archer

Fatigue Strength and Strain Relief 39
By Charles H. Jennings

The New Resistance Welding 42
By M. L. Eckman

Economy in Welding Operations 45
By E. Lunn

When a Driveway Had to Be Widened 47
By Frank P. McKibben

Building a Job Welding Business 49
By W. Irving Brockson

Editorial 23

Events and News of Interest 51
New Literature 53
New Products 54
News of the Industry 56

The Picture on the Cover*

Will He Get the Job? **The reduced section tensile test specimen being pulled in the machine was made by a welder as part of the qualification test required by the new pressure vessel code. The employer and the welder are equally interested in the laboratory report. "Will He Get the Job?" is the title of an article starting on page 31, and discussing qualification tests in great detail.**

**Test specimen furnished by courtesy of Chicago Bridge & Iron Works, Chicago, and photograph by courtesy of Robt. W. Hunt Co., Chicago.*

Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

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EDITORIAL

Products That Must Be Right

HOME building by the welding processes seems to be no exception to the general rule and each new application, while in the experimental state, depends for its complete success upon a good understanding of all of the things which happen when metals are handled at high temperature. It is just beginning to be realized that welded homes are not only practicable but that they probably constitute one of the major developments for the next two or three years. It is true that the idea is not new and that a few homes have already been welded and that some of these did not show what might be called startling economies. Considered in the light of these facts, the subject of welded homes might be lacking in real interest. On the other hand, there is the possibility of welded steel homes by demand because they are better. Construction features which are obtainable by no other method will appeal to a public which has become accustomed to expect new values in all commodities.

It is evidently this line of reasoning which has led to large scale plans for the production of welded steel homes backed by some of the largest industrial firms in the United States. One rolling mill, through its subsidiary companies, has under construction several "samples" embodying design features which are altogether new and which anticipate low cost construction because of the adaptability of designs to mass production. Another large concern has been working for a long while on the mass production of small homes of welded construction and was recently reported to have asked for bids on 25,000 electric refrigerators. A comparison of this figure with the number of steel residences so far produced gives an entirely new picture of the future importance of welding in home construction. These large scale efforts can result only in popularizing the idea. Similar ventures on a smaller scale will develop as a natural consequence. It will be remembered that fifteen years ago there were only a few pipe line companies who had the temerity to weld long overland pipe lines and today there are scores of such companies. The building field is bound to attract new capital and new enterprises, just as the pipe line field did.

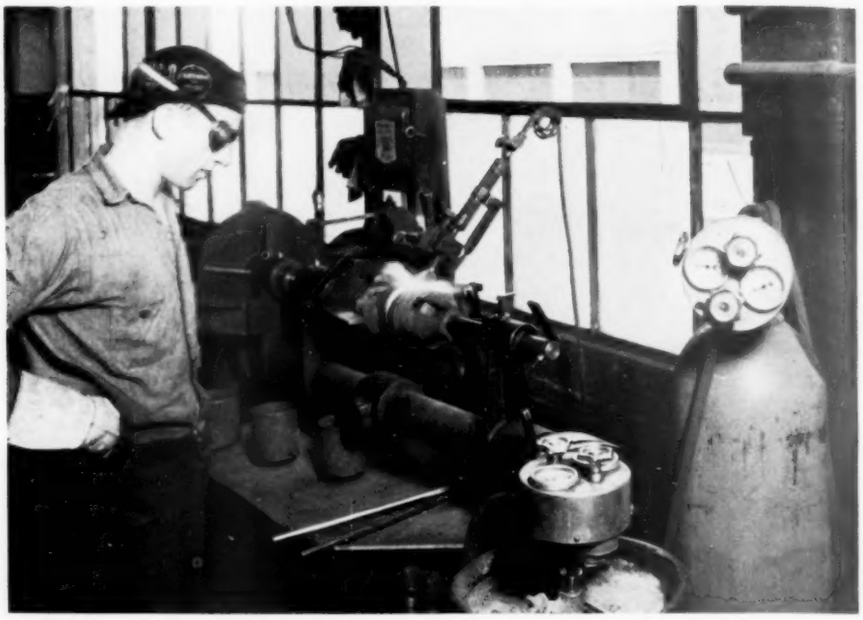
It is in carrying out the plan to the complete satisfaction of the customer that the men behind these ventures will have to be alert to the possible difficulties which may come up in any welding application. Building frame work, steel walls, steel floors and steel roofs are products which have to be right. The tolerances as regarding warping are bound to be closer than the many other products fabricated of standard structural shapes, sheets and light plates. There is abundant opportunity to spoil some good jobs by not knowing how to take precautions against excessive warping in a structure as large as a residence. There is also plenty of opportunity to misjudge the stresses to which some joints will be subjected and, consequently, to underestimate the strength which some of these joints should have. The real difficulty is not the matter of safe construction, but of construction which will not be disappointing to the home owner in the appearance of the finished building. It will pay to make haste slowly in this field because the country is facing a potential demand for many thousands of new residences. The steel industry produces materials which offer real advantages in home building. The welding processes furnish what is practically an ideal method of assembly, and there is a big volume of business directly ahead if it can be developed without any unnecessary failures.

The Time for Action Is Here

PLANS for a general reconstruction of industrial and financial program now under way promises to result in a steadily increasing gain in business activity. One movement, particularly deserving of support at this time, is the national campaign against hoarding. If one reads only the headlines, it will be easy to get the understanding that this is more than merely a campaign to stimulate the spending of more money. The real purpose of the campaign is to abolish the attitude of fear and trembling and replace it by an attitude of confidence. It is estimated that there is well over a billion dollars of currency tied up which could be productive of ten times that much credit, if put to work properly. There is plenty of opportunity under present conditions to make sound investments—investments which will release other dollars and build up the values of existing securities. It is certain that the Reconstruction Finance Corp. will function to improve the banking situation. This alone is an invitation to put the idle dollars to work, and assurance that this can be done safely. The time to act is right now when the Reconstruction Finance Corp. is getting under way with its good work. Every individual should study in detail such announcements as are made from time to time regarding the progress of the campaign against hoarding. It will be evident immediately that this movement depends on the individuals and that the individuals have more to gain by active co-operation than by standing by to observe the outcome.

Welded Construction Is Better

IF PRIZES were being awarded for excellence in presentation of welded construction, there is one recent piece of publicity which would certainly be up for very strong consideration. This item is a description of the welded construction for the frames of drilling machines, which appears in the current issue of the Armstrong Driller published by the Armstrong Manufacturing Co., Waterloo, Iowa. This discussion traces the progress made in drill construction from the old type of wood frame, through the riveted frame up to welded construction, which was adopted in 1929, and is presented here as the modern manufacturing method. Emphasis is placed upon the fact that the welded connection is stronger and that the old machine has been improved by the adoption of this construction. Further emphasis is placed upon the quality of the workmanship by giving details of selection of experienced and capable welders



NORGE
Saves 50% on one Operation by REGO *Welding Methods*

In the building of Norge Refrigerators it is necessary to produce a refrigerant liquid receiver, a 14-gauge steel cylinder 4 inches in diameter by 10 inches long, made from two cup-shaped halves, joined at the center girth seam by welding.

Originally a hand-operated oxy-acetylene torch was used, but it was difficult to secure uniform appearance and freedom from leaks. Semi-automatic electric welding also proved unsatisfactory.

Rego Welding Engineers were consulted and after careful study, suggested a special welding machine, shown in the illustration, which it was estimated would produce 41 completed welds per hour with a consumption of 0.59 cu. ft. each of oxygen and acetylene per piece.

Over an operating period of several months this machine has actually averaged 45 finished welds per hour with a gas consumption of only 0.53 cu. ft. of each gas per piece. The machine has cut the cost of the operation 50%. Under hydrostatic test pressures of 1500 lbs. per square inch, leakage rejects have been limited to less than one per cent! The weld is smooth and uniform, and requires no grinding or finishing before enameling.

Submit your welding problems to Rego Welding Engineers. Recommendations for methods and equipment that will reduce costs or improve the product will be cheerfully made without obligation.

THE BASTIAN-BLESSING CO.

246 East Ontario St. Chicago, Illinois

"The Satisfaction of Work Well Done"

THE MONTHLY SYMPOSIUM

Hard Surfacing

Rural

The farmer's first introduction to the hard facing process was through demonstrations of savings made by building up worn plowshares. Now it appears that the process is being extended to many similar parts of agricultural equipment. Its large scale use by the Collins Farms Company, Cedar Rapids, Iowa, was described in a paper read before the welding conference recently held at Iowa State College, Ames, Iowa, by W. T. Saxon of the Collins organization. Among the important parts on which the hard facing process has proved to be economical he mentioned plowshares, cultivator shoes, disc plows, cultivator shovels, mower shoes, feed pulverizing hammers, threshing cylinder teeth, cultivator teeth, potato ditching teeth, lister shares, corn planter shoes and harrow teeth.

Good records have been kept by the Collins Farms Company to indicate the results obtained. On one particular unit a farm of 280 acres was plowed with a regular plowshare without a hard faced edge. The regular shares were changed on an average of every six hours and it was necessary to replace twelve of the old shares with new ones. The total expense was $194 or an average of 69 cents per acre. On an adjacent unit of 160 acres plowing was done at the same time and under the same conditions with shares which had been faced with Haynes Stellite. The shares were kept in operation from 55 to 60 hours and none of them were repointed. All of them were considered as having some value when plowing was completed. The net cost in this case was $41.25 or an average of less than 26 cents per acre. The records indicated that the hard faced shares plowed an average increase over the soft shares of over 800 per cent. Because of the saving demonstrated this company is using hard facing on plowshares for practically all of their work, 14,000 acres having been plowed in 1931. One plow plowed 285 acres without the shares being removed, bringing the cost per acre on this piece of work down to 4½ cents.

Comparative results were obtained in cultivation. There were over 30,000 acres to be cultivated during 1931 and some of them were gone over as many as four or five times. The records show that new field cultivators with sweeps, or points, that were not hard faced covered only 180 acres before the sweeps, or points, needed sharpening; whereas, the sweeps, or points, that were hard faced with Stellite were not sharpened during the entire season's work over 850 acres per cultivator. Cost figures indicate that using the ordinary sweep without hard facing increased the upkeep cost on sweeps nearly 700 per cent.

On this group of farms the hard facing operations during the past year included nearly 1200 plow shares, nearly 1,000 field cultivator sweeps and about 2,500 applications on other cultivator and planting parts.

Tire Chains

A welder in the northwest, who apparently had little prospects of getting much work to do through the winter months, was able to develop a fine line of business by taking advantage of the fact that tire chains wear out, according to an article in the January issue of *Oxy-Acetylene Tips*. In a period of two months, he hard faced 32 sets of truck chains with most satisfactory results. As an example of the economies obtained, it was noted that in this part of the country a set of 30x6.00 tire chains of the extra heavy duty type, having 11 cross chains on each chain, would give only about 120 miles of service before becoming worthless. However, when these worn links were hard surfaced, the total mileage obtained from the original links was over 400 miles.

This welder found that the best time to make a repair is when the cross links are worn approximately half through because this gives a good flat surface on which to work. The five middle links in each cross chain are the ones which require treatment. The procedure is simple as the chains are simply spread out on a welding table, flat side up and the worn links built up to the required size with Haynes Stellite welding rod. The cost is less than replacing the worn cross chains by 17 per cent. Thus for an outlay of less than the cost of replacing, or renewing, the length of service of these tire chains was increased from 120 miles with one set of cross links to 400 miles with the first set of cross links built up. Customers who had their tire chains surfaced in this manner were entirely satisfied and the welder has created for himself a profitable line of work which promises to continue.

Paddles

In a photographic contest sponsored by the Stoody Company of Whittier, Calif., sometime ago one of the entries, submitted by S. B. Troyer, superintendent of the Evergreen Mining Company, Ironton, Minn., was the accompanying photograph of pug mill paddles surfaced

Hard Surfaced Pug Mill Paddles Last Six to Seven Times Longer.

with Stoodite. A drum type pug mill was being used to convey and mix the feed to a sintering machine. The paddles mixed about 125 tons per hour of a very abrasive iron ore, returned sinter and crushed coke which, mixed with water causes considerable wear on paddles. Originally the life of these paddles was from 6 to 7 days. A set faced with Stoodite operated for 37 days and conveyed about 10,000 tons of this abrasive material. The original paddles were electric steel castings costing about $115. To renew them a piece of ½ in. boiler plate is welded to the blade and a complete set of paddles all ready for hard surfacing is prepared for slightly less than $25. The complete cost of putting on the Stoodite is about $67 per set. It is also mentioned that the scraper used to keep the pug mill drum clean is made to last six or seven times as long by using Stoodite on the wearing edges.

Procedure

In the current issue of *Fusion Facts*, published by the Stoody Company, Whittier, Calif., there is an extensive treatment of various Borium products with detailed explanations of just how these products should be applied. The plain Borium is furnished in uniform rectangular shapes ⅛ in. thick, ¼ in. wide and

any length from ¼ in. up to 2 in., and in pea form in various sizes. The plain pea Borium is usually applied with the oxy-acetylene torch. A cutting torch is first used to make small niches. The pea is brazed to the end of a high carbon welding rod, so that it can be placed exactly where it is wanted in the niche and melted off the rod exactly in place. When enough of them have been applied, the whole surface is overlaid with another hard metal such as Stoodite. The rectangular shapes are applied in the same way.

Then there is the plain, or uncoated, tube Borium which is recommended for application by the oxy-acetylene method only. No filler rod is necessary because the tube serves this purpose. There is also a stainless tube Borium which is applied only by the oxy-acetylene method.

Special electric tube Borium is made for application by the metallic arc process, the tube being used as the negative electrode, and the machine being set at 150 amps.

Finally, there is Borod, a tungsten carbide product, which can be applied either electrically or by the oxy-acetylene torch. When applied electrically, it is necessary to use the rod as a positive electrode and to use about 150 amps. in the application. When applied with the torch, a medium size welding tip should be selected and adjusted to a slightly carbonizing flame.

While there is a great deal of similarity in these products both as to composition and to fields of usefulness, there is a distinct difference in the procedure of application. If a welder desires to do his work with the oxy-acetylene torch, he must select the product which is best applied with the torch. On the other hand, if he wishes to apply it with the arc, he must be careful to select the materials that are made for arc welding applications. Some of these materials, which were originally produced chiefly for the oil fields, are rapidly finding applications in excavating equipment, road machinery, agricultural implements, railroad equipment, steel mill machinery and grinding machinery. A good deal of grief and unnecessary expense will be saved by making a careful study of the correct procedure.

Tanks and Containers

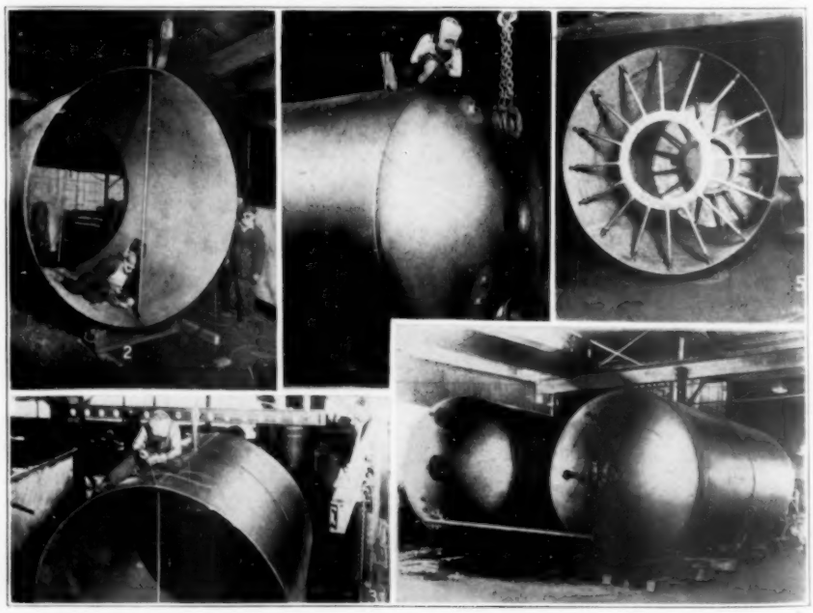
Everdur

Everdur is a copper alloy made by the American Brass Company which combines the strength and fabricating qualities of steel with high resistance to corrosion and rust. It is used extensively in tank construction and is readily welded by either the gas or the electric arc process. The accompanying photographs show various steps in the construction of two 10,000 gal. hot water accumulators fabricated by the Whitlock Coil Pipe Company of Hartford, Conn., for the Berkshire Knitting Mills, forming a part of a processed hot water system installed in the mills by the Whitlock concern. These accumulators store water at 210 degrees F. and at a pressure of 85 lb. The processes in the mills require pure, clean, hot water at specified temperatures for mixing dyes and washing fabrics and the quantity demands are so great as to necessitate accumulators of exceptional size and strength.

The accumulator tanks are 22 ft. long and 9 ft. in diameter. The shelves are ½ in. thick and the heads .65 and .76 in. thick. This provides ample factor of safety and no extra allowance has to be made for progressive corrosion. The tanks were fabricated by the metallic arc process using Everdur electrodes. After they were completed they were tested twice for 24 hours under a constant pressure of 200 lb. per sq. in. and no sign of leaks or failure could be detected. With the pump shut down and valves closed, there was no drop in pressure, knowing that the shelves were carrying the loads with no change in shape.

The fabrication of the Everdur plate in all the preliminary operations of shearing, scarfing and rolling were the same as if the metal had been ordinary low carbon steel. Each bead was peened before applying to the next one and after completion of each seam, the weld area was reheated with the welding torch to a dull red. There were 125 lineal feet of welding on each of these tanks exclusive of the welded-in fittings and nozzles. The heads were flanged and dished. This metal is said to be rapidly increasing in use in the field of domestic hot water tanks, most of which are all-welded construction. In some cases, these are fabricated on automatic welders, but in other cases, these are constructed of seamless cold drawn shells with one head left in and a pressed out bottom welded on. Among the rigid tests to which this metal was subjected before being adopted for this use is a "breather" test which consists of a pulsating pressure in the tank from zero to 150 lb., thirteen times a minute. Five hundred hours of this test is considered the equivalent of 20 years normal service. Everdur tanks have been held on this test for over 1,000 hours without showing signs of leaks or distortion.

A more severe test to which this material has been subjected involved the application of pressure by means of a piston arrangement which variated the pressure from zero to 300 lb., fifty-three times per minute. Shell tanks 12 in. in diameter, 48 in. over-all and made from .056 gauge metal were held on this test for 700 hours and then tested to 700 lb. hydrostatic pressure without showing any signs of failure or change in shape.



(Above, Left) Arc Welding Inside Seam. (Center) Welding One of the Heads. (Right) Spider Forms Used to Retain Shape of the Shell. (Below, Left) Welder Working on an Outside Seam. (Right) Tanks Undergoing 24-Hour, 200-Lb. Pressure Test.

Safety

About two hundred engineers and oil company executives were present when new types of safety heads for pressure vessels were recently demonstrated in the Tulsa, Okla., yard of Black, Sivalls & Bryson. These new safety heads consisted of thin, soft metal diaphragms which are formed before use into a special curved contour, the strength of which, it is claimed, can be calculated. These diaphragms are said to remain absolutely gas-tight indefinitely at the rated working pressures of the vessels to which they are attached, but will burst and fly into small harmless pieces, leaving a clear, round, unobstructed opening for the escape of gases in case their rated working pressure is exceeded by about fifty per cent.

These safety heads are advocated by Black, Sivalls & Bryson, as offering far more adequate protection to insure the safety of operation of high pressure vessels or piping, particularly when the use is likely to subject them to extremely large volumes of high pressure gas—as, for example, in oil and gas separators, where it has long been recognized that the single pop valve customarily installed, one on each separator, can be expected to relieve only a few percent of the tremendous volumes of gas which might enter the separator in an emergency at high pressure, and would be sure to burst the separator in case its exits were accidentally closed.

The bursting of these diaphragms is said to open a free area large enough to relieve many times the volume of gas which can be discharged through a pop valve of corresponding size. They are not intended to be substituted for pop valves, but are advocated to be used in conjuction with pop valves, offering a greater measure of protection to insure that it will be practically impossible to burst the vessel, with its consequent likely destruction of property and loss of life, because the bursting of the safety head, at a pressure somewhat below the hydrostatic test pressure of the vessel, will relieve an opening large enough to prevent further rising of pressure in the vessel.

The first head demonstrated was a little 2 in. size intended for 200 lb. working pressure use such as a small separator or a piping manifold, or possibly a steam boiler. This head exploded at an air pressure of 310 lbs. The opening left was round, smooth, and of the full 2 in. diameter of the head.

The second head demonstrated was 4 in. in size, contemplated to be used in connection with a 250 lb. working pressure gasoline plant vessel, or possibly a 250 lb. steam boiler. It burst at exactly 370 lbs. rated failure pressure. The opening was free from obstruction.

The third head tested was one of the large 10 in. diameter heads which is now being installed as a regular feature of the B. S. & B. Oklahoma City type oil and gas separators. This head burst, as intended, at 240 lbs. per sq. inch, which is a little more than 50 per cent in excess of the 150 lb. working pressure of the separator to which it is attached. Black, Sivalls & Bryson claim that the bursting of this 10 in. safety head will open a smooth edged orifice capable of relieving 165,000,000 cu ft. of gas per day, and is thus capable of entirely protecting any separator even if the well should be turned into it without other outlet.

It is further stated that the danger from sparks and fire has been eliminated by the use of copper or other soft material for the safety head, and it is stated that these heads have been tested against fatigue failure over a rather long period of their probable life.

These heads can be made in any practical diameter and thickness to suit various bursting pressures.

Maintenance Welding

Foundries

The frequent breaking of equipment in foundries opens up a wide field of usefulness there for bronze welding. A recent bulletin of the American Brass Company features the accompanying illustration of 8 welds made with Tobin bronze in 3 hydrant flasks in three hours. Iron flasks unavoidably receive rough, hard usage and very often are made up of comparatively thin sections, so

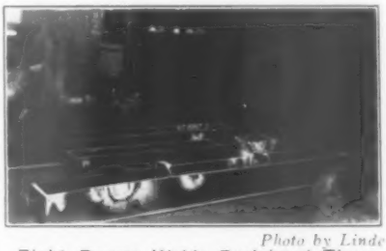


Photo by Linde

Eight Bronze Welds Reclaimed Three Flasks in Three Hours.

that it is the usual thing for several to be damaged in the course of an ordinary day's work. If the flasks are heavy enough to require handling with a crane, the possibilities of breakage are considerably higher. The bronze welding repair can be done so quickly and with so little preheating that it makes for real economy on this kind of a job.

It is pointed out in the bulletin that bronze welding has other valuable uses in the foundry. Many foundries use iron patterns which are cracked in handling and wear thin from contact with the sand. The bronze rod can be used either to repair the cracks or build up the worn places. It can also be used to change patterns to meet changes in designs, for filling up holes and increasing thickness and for building on lugs. Furthermore, reject losses can be considerably reduced by repairing defective castings. Blow holes and pits can be chipped out and other defective spots can be chipped or cut off, built up and then machined to size.

As an indication of the economy, it is stated that one foundry used pipe flasks weighing 8,000 lb. and costing $125 to cast in the foundry. To bronze weld a 6 in. crack in one of these flasks costs $10.50 including preparation and welding, labor and material. An average of two flasks a day are repaired in this foundry with a saving estimated at $200. This amounts to a total annual saving of about $60,000. In another foundry a bath tub flask was broken in three places necessitating 8½ ft. of repair welding on metal averaging 1 ft. in thickness. The cost of the repair was only $11.40. Average repair costs in this foundry are said to be $6.00 per flask and an average of four are repaired daily. The flasks cost from $60 to $100 to make and the estimated saving is said to be in the neighborhood of $72,000.

In this work much of the welding is done on the surface of the metal so that the cost per foot of seam is little larger for a repair in a 2 in. wall than in a 1 in. wall. It is estimated that a break in 1 in. metal can be repaired for $1.35 per foot and in 2 in. metal for $1.75 per foot.

Corrosion

Chrome nickel steels are being used extensively in the fabrication of metal articles of all kinds where resistance to corrosion is desired, resulting in a product which does not deteriorate when subjected to the corrosive action of water or acids. Apparently it has not occurred to very many welders that this material has a possible application for the reclamation of parts which have become unserviceable as a result of corrosion. This use of stainless steel welding wire is, however, suggested in a piece of advertising matter recently sent out by Maurath, Inc., of Cleveland, Ohio. It contains a photograph of a large turbine runner, the blades of which had been badly corroded. This

was made fit for additional service at a comparatively low cost by depositing an overlay of stainless steel on the corroded areas with the electric arc. Since this material is hardened by cold working, it is said that the overlay shows a corresponding resistance to wear, making the repair an altogether very satisfactory job to the owner of the power plant where the runner was in use.

Saddle Casting

An interesting repair of a locomotive saddle casting is illustrated in the accompanying photographs which were furnished through the courtesy of the Commercial Gas Co., of Minneapolis, Minn. This saddle casting had been welded before and it broke in the weld, so that in order to make a satisfactory repair it was necessary to cut out the entire old weld as shown in Fig. 1. It was then rewelded, using "Arcast" cast iron electrodes deposited with the electric arc. Fig. 2 shows the other side of the casting after the repair had been completed. The job attracted the special attention of officials of the railroad and the results were noted very carefully. The locomotive has been running on a passenger run between Minneapolis and Chicago for about six months. It is still absolutely tight and it is thought that the life of the casting

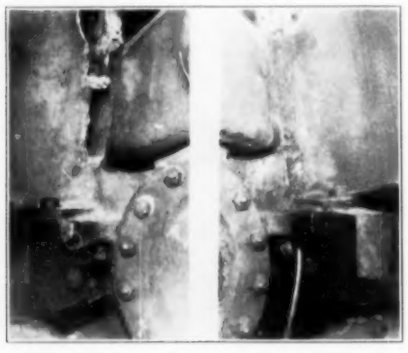


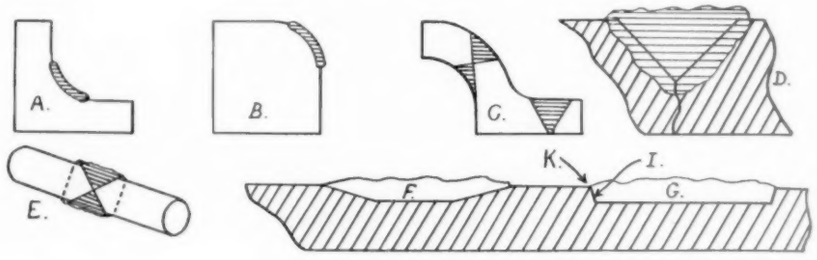
Figure 1. (Left) Old Weld Cut Out. Figure 2 (Right) After the Reweld Was Finished.

is now indefinite. It is one of those jobs which show outstanding economies. The total expense of welding was less than $100.00, but it possibly saved a $1,400.00 casting in addition to the expense which would have been involved in taking out the broken casting and replacing it with a new one.

Castings

Some useful suggestions for arc welding repairs on cast iron parts are shown in the accompanying sketches, taken from an instruction sheet furnished by the Wesco Engineering and Sales Co., Wilkinsburg, Pa., for use with the Wesco blue iron electrodes which are made for arc welding cast iron. It is recommended that welds be peened to relieve the contraction strains, so that they will not be forced to stretch when cooling. This peening is recommended for welds of the type shown at A, B, C and D in the sketch. The weld, as shown at E, where the added metal completely surrounds the part to be welded, as in welding around a square or round bar, does not require peening as a rule because the contraction merely grips the parent metal that much tighter. Provision must be made, however, for contraction if both ends of the bar are in a fixed position, so as to make a rigid type of weld. In the welding of blow holes in castings which are to be machined, the preparation of the work is very essential. The work should be chipped out to a depth of at least $\frac{3}{16}$" deeper than the final finishing cut and care should be taken not to taper off the edges of the chipped area as shown in Figure F. This condition broadens out the junction line to a point where an excess of carbon is absorbed by the weld right at the point of machining. The proper way is to cut down the edges at 80 or 85° as shown in figure G, thereby reducing to a minimum the chilled area which must be machined. Using reverse polarity will aid in absorbing the excess of carbon.

When starting to weld a section, as shown at G, it is advisable to confine the arc directly in the bottom corner and not allow it to play upon the surface any more than is necessary to deposit metal slightly more than flush. The point K should be more or less welded by contact fusion, allowing the metal while in a fused condition to pile over and fuse at this point, thereby reducing any indentation caused by the burning away of the iron where directly in contact with the arc. Care, of course, must be taken that this point is hot enough so that actual fusion will be obtained. It is advisable, but not always necessary, to peen the weld after each electrode is deposited. When the first corner weld in corner I has been completed, the additional metal deposited in the center must be peened down to prevent its contraction from breaking the fusion line at I.



Various Types of Casting Repairs Which Can Be Made with New Procedure.

Production and Fabrication

Ingenuity

The John Evans Welding & Mfg. Co., Sumter, So. Car., have been manufacturing Sumter Trailers for the past eight years and have been extremely successful in the making and marketing of their products. The outstanding feature of these trailers is the ingenious design and careful workmanship which enables them to get full value out of every pound of metal put into the trailer so that the product has the combined features of lightness and reliability. This manufacturer has apparently made a thorough study of stresses and strength of materials.

Ever since this company has been in business, they have electric welded the frames at every joint. The frame, axles and all other parts are cut out with the oxy-acetylene torch. "The Sumter Trailers are made in two and four wheel units, from one to twenty ton capacity," writes R. G. Wilson of the Burdett Oxygen Company, Atlanta, Ga., who sent in the accompanying photograph. "They are designed for hauling practically everything. It is an inspiring

Ingenious Design and Careful Workmanship Insure Lightness and Reliability

sight to see one of their big trailers loaded with 25 or 30 bales of cotton headed for the market. There are many good trailers on the market and many of them would covet the fine record of efficiency and performance which the Sumter Trailers can boast."

Oil Spray

An arc welded oil spraying unit was recently built by the Emil Howe Welding Company, of Los Angeles, California. This piece of equipment is used in spraying highways for completing the finished surface in certain types of road construction. The unit functions by means of pressure maintained by a motor and pump mounted in the frame, which is trailed behind a truck tank containing the supply of oil. The oil is fed to the sprayer by a three-inch hose and pipe connection leading from the tank truck, and is sprayed through a row of sixteen valves at the rear of the unit.

The frame of the sprayer is of all-welded steel members. A Continental motor is the power medium used to maintain the pressure for spraying the oil, and is secured to the frame entirely by welding. This feature is shown plainly in Figure 1, which is a closeup side view of the center of the unit. This photo also shows the pump installed,

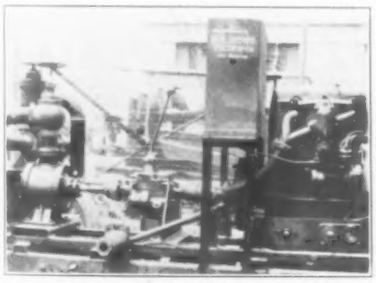


Figure 1. Welded Frame with Gas Engine Power.

the gear shift and control lever, and all-welded gasoline tank. The main drive shaft, shown also in this view, is also of all-welded construction.

Figure 2 is a rear view showing the spray valves and spray control lever, hoist drum and hoist proper used for raising and lowering the spreader header, all of which are also of welded construction. The hoist is operated by a power take-off. The header is made to accommodate a two-foot extension on each end for added coverage when needed. The main pipe leading to the header is three-inch.

Mr. Howe, the builder and designer, states that very few bolts were used in constructing this spraying unit, welding being employed at every point possible, even to welding the few bolts that were used, after they were tightened.

The gas tank for the motor of the unit was bolted to its support instead of

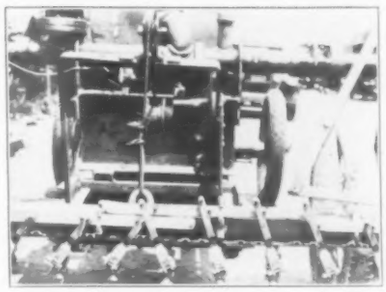


Figure 2. View Showing Sprayer Units and Controls.

being welded, from necessity, due to the fact that its removal from the place it occupies will be necessary when the time comes for repairs to the motor.

This spraying unit was designed and built for the Tulare (California) County Highway Department for use in county road construction and maintenance, and its performance is highly satisfactory.

Time

"There is one case in our factory where today three men are turning out the same amount of welding work done three years ago by eight men. It was then, and still is, a hand welding job," stated P. J. Horgan, of the General Electric Company, at the recent convention of the American Institute of Steel Construction.

"Formerly, half of the man's time was spent in handling his work alone, moving it about into correct working positions. Breaking down the time into the two elements of handling time and welding time, we first improved the facilities for getting the work to and from the welder and then analyzed his welding facilities. By establishing the maximum current commensurate with the desired quality we were able to cut costs in half without imposing extra hardship upon the workman.

"Welding time must be separated from handling if proper analysis is to be made of methods, etc., to obtain low costs.

"Time for handling is contingent on facilities of the shop, nature of the piece being welded and quantities being produced.

"Time for welding may be based upon the theoretical figure that in the well organized welding shop one kilowatt hour of energy at the arc is required to deposit one pound of weld metal. This pound of metal can be translated into any terms desired—that is, inches of electrode wire per inch of fillet of a given size, volume of weld metal for a butt welded joint of a certain size, etc.

"Experience seems to indicate that this theoretical balance between power and weld metal should be multiplied by a factor of 75 per cent to compensate for losses due to spatters, starting the arc, holding back slightly to bring both sides of joint up to fusion temperature, variations in the size of the fillet, filling the craters and a small concession to the variations in the welder's technique to obtain desired appearance of his weld.

"The most common size of fillet weld is 3/8 in., measured on each leg of the right triangle. The average current used to produce this weld is 200 amp. for horizontal welding and 175 amps. for vertical, with approximately a 20-volt arc in either case.

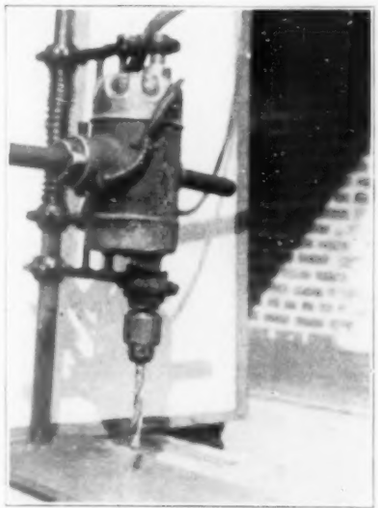
"This represents 4 K.W.H. of energy or 4 pounds of weld metal reduced to about 3 pounds per K.W. hour for practical purposes."

Sheet and Plate Work

Drill Stand

The all-welded portable electric drill stand shown in the illustration is simply constructed of two ordinary automobile connecting rods, a couple of pieces of cold rolled rods, a piece of ordinary shafting, and a couple of old truck valve springs, all properly assembled and welded to a piece of boiler plate as a base for the stand.

The main post on which the drill operates is a piece of 1¼-inch shafting. A special adjustable lever combination attached to the center arm provides the means of raising and lowering the drill. Note that in the use of the two connecting rods, the one with the bearing end is used on the lower side, while the one with the wrist pin end is used for the upper. Old truck valve springs act as the means to provide



A Knack for Putting Things Together and the Welding Process Provides Many Handy Pieces of Shop Equipment.

better control of the pressure on the bit and to elevate same when the drilling operation is completed. The base to which the main post of the stand is welded is of one-half-inch boiler plate, which completes the job and makes it convenient for moving about in the shop.

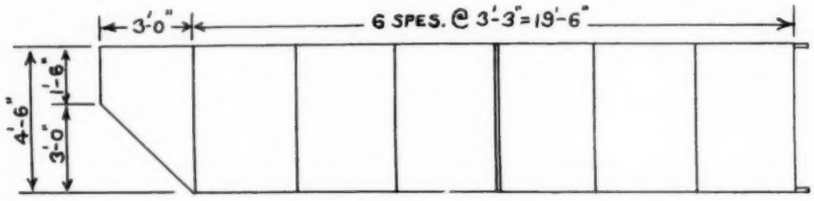
This handy and inexpensive piece of shop equipment is among a number of similar all-welded articles which have been designed and built recently by Al Joslin of Los Angeles, California, for us in his new shop located on West Manchester Avenue in that city.

(Left) Absolutely Water-Tight and Light of Weight Because It's Welded. (Right) Moving the Barge to the River.

Barges

By Fred H. Marsh

Arc welding was used throughout in the construction of a steel barge recently built by the Patterson Steel Company of Tulsa, Okla., for the Rucks-Brandt Construction Company of that city. This barge is to be used for sand pumping in connection with the construction of a new reinforced concrete arch bridge at 21st Street in Tulsa.



Dimensional Sketch of the All-Welded Steel Barge.

The barge is made up in four sections. Each of these sections was completely welded in the shop. After being tested in the shop by filling with water, the sections were transported by truck to the river bank, where they were launched and fastened together by means of vertical pins. The completed barge is approximately 20 ft. wide by 45 ft. long by 4 ft. 6 in. deep.

The frame work of each section is an ingenious combination of angles and channels. The top member of each side frame is a 3 ft. by 3 ft. by ¼ in. angle, and the bottom member is a 6 ft. by 4 ft. by ⅜ in. angle. The transverse members on the bottom are 8 in. by 11.5 in. channels and the top transverse members are 6 in. by 8.2 in. channels. These are spaced 3 ft. 3 in. apart both top and bottom. Side stiffeners of 2½ in. by 2½ in. by ⅜ in. angles join the transverse members at top and bottom by welding. The end section cross bracings are 2½ in. by 2 in. by ⅜ in. angles.

The bottom side plates are ¼ in. thick and the deck has a cover plate of ⅜ in. thickness. Each of the sections is divided transversely into two compartments by a partition ⅜ in. plate, making a total of eight compartments in the entire barge. Welded construction was used throughout, with the exception of the deck plates which were bolted on. The pins used for holding the four sections together are 1¼ in. mild steel rods with square heads welded on. The side and end plates are joined to the top rail by a continuous ¼ in. full fillet weld on the outside and ¼ in. fillet tack welds on 1 ft. centers at the bottom of the 3 in. x 3 in. x ¼ in. angle on the inside. A continuous ¼ in. full fillet weld, water tight, was run along the 6 in. x 4 in. x ⅜ in. angle making this connection water tight.

This construction provides a comparatively light and very serviceable barge at low cost with the advantages of tightness and ease of maintenance.

Pontoons

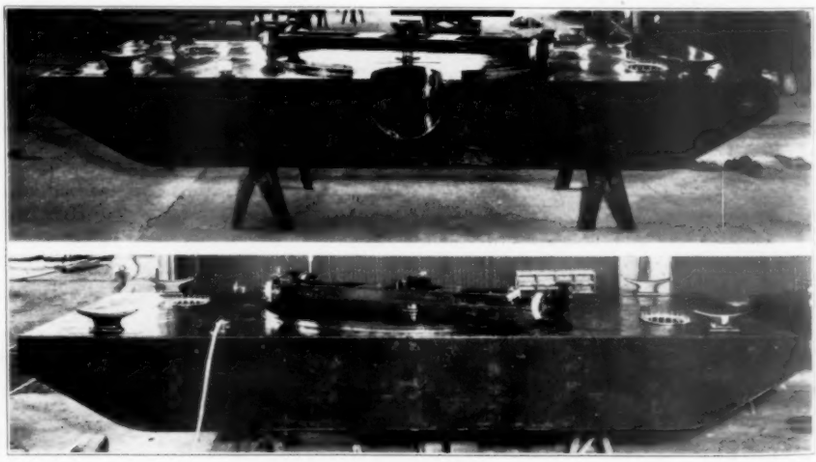
The Chicago Bridge and Iron Co. (Birmingham Plant) have just shipped 20 steel pontoons to Vicksburg, Miss., for carrying 16-inch pipe line for dredging out the sand bars along the Mississippi river. These were made for the civil service department of the United States government.

These were all made of ¼" steel plates and are 12' wide x 25' long x 3' high. The hulls were stiffened by angles. Both the angles and the hulls were electric welded throughout.

According to the shop foreman at the plant the government has for some time been using pontoons for such purposes but has in the past been using rivets for joining them. This of course allowed leaks to occur, and on top of this was more expensive.

These pontoons present a very neat appearance and are of very solid construction. No rivets were used either on the hulls or stiffening angles. They are equipped on the top with turn-tables to allow the pipe to be run in any direction.

There are two different types of pontoons. One type is for the regular line, and the other for the home joint, which is equipped with a groove allowing a bend in the pipe to go down in the river to reach the sand bar. The line is then attached to a pump and the river dredged out to any point desirable.



These Welded Pipe Pontoons Are Both Lighter and More Economical to Construct

Will He Get the Job?

Qualification tests serve two very important purposes: (1) They furnish a complete solution of the "problem of the human element; (2) They practically eliminate the tremendous losses which accumulate as a result of poor workmanship. This article furnishes qualification tests, applicable to sheet and plate welding, pipe welding in buildings, pipe line welding, structural welding, tank welding and tube welding.

A WELDER who has been welding for a good many years on all kinds of production and repair jobs applies for work in a plant where they need a man for welding pressure vessels which have to meet code requirements. Will he get the job? A younger man who has applied himself very diligently to the training program in a good welding school applies for a job as a pipe line welder. Will he get the job? A sales engineer for a large firm of piping contractors goes after the contract for welding piping on a new power plant installation. Will he get the job?

The significance of the growing tendency toward using qualification tests to prove the ability of an organization to produce a satisfactory welded installation is that this tendency affects both the employee and the employer. Code requirements for the qualification of welders cannot be ignored. Therefore, all work covered by codes makes it necessary for the employer to qualify his men before they even start to work. It follows, of course, that operators who cannot pass the conventional qualification tests are automatically eliminated from jobs covered by such regulations.

Since the qualification test has been accepted under such circumstances as a protection against failures due to poor workmanship, it is to be expected that more and more employers of welding operators will adopt this same plan for keeping the workmanship in their own plants up to a certain standard.

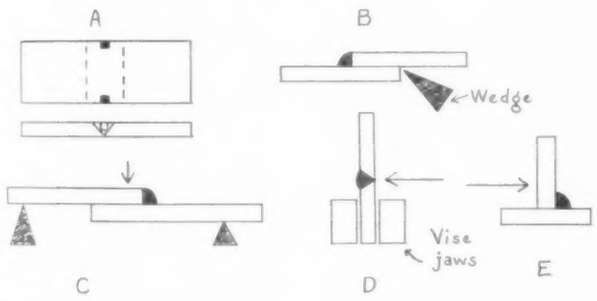


Figure 1. Inexpensive Methods of Determining Weld Quality by Visual Inspection.

For plant managers who are thinking along these lines there are two things to be considered: First, that the qualification test need not be an expensive matter—in fact, it should cost less than the failure of one poor weld would cost. The second point is that no single method or procedure for qualifying welders can be made to apply to all classes of welding. The code qualification tests for welders for one class of work may be entirely too rigid to be practicable or even desirable for use on another class. Even in the case of a single classification, such as structural welding or tank welding or pipe welding, it has been found that it takes a long time for a number of authorities familiar with any one class of work to come to a common agreement on a definite program of tests to qualify welders for that class of work. When that agreement is reached, it will be a good deal of a compromise. This difference of opinion emphasizes the importance of studying each job with an eye on the final result.

The qualification test should not be misunderstood by the operator as an attempt to prevent him from getting a job. There is no reason why any operator should not become acquainted with his own limitations through failure to pass a given test and learn how to correct his own faults so that he will be successful on his next attempt. There is no reason why his pride should be hurt by a single failure, because that failure may simply be a reflection upon the kind of training which he has had and on supervision which he has had in his work and which has allowed him to continue to weld without being aware of his limitations. Under some circumstances a certificate of qualification might be a very valuable asset to a welder when applying for a job in competition with other operators who could produce no such evidence of ability to make a good weld. Neither should the employer consider it necessary to discharge all welders who are not able to pass a qualification test on the first rial. Many such welders have a great deal of latent ability which can be developed by proper training. Defects can be corrected and men can be returned to the job with an increased respect for their trade and for their employer and with the realization that it is to their own interest to maintain high standards individually.

All those who are sincerely interested in the advancement of good welding practice will agree that a more wide-spread use of qualification tests will be productive of very much good in the welding industry. There is one way in which such tests can be used to eliminate the economic losses caused by poor workmanship and accomplish this on short notice; that is by the adoption of qualification tests in all training courses. This would include welding courses in public schools, trade schools, welding schools and industrial plants. If all the men who are being given instruction at the present time were required to pass a qualification test as the last exercise in the instruction program, the training standards would be improved enormously. The principle of this theory is simply a matter of considering the instruction to be required to develop a certain ability in the student, rather than simply requiring the student to go through a certain routine of instruction and practice.

It is a short-sighted policy to look upon a qualification

test as an increased expense. Any employer who wishes to test the truth of this statement can readily do so by comparing the cost of even the most elaborate test program with the high cost of rapid labor turnover and the high cost of imperfect workmanship on any production welding job of any consequence. It has been demonstrated in many plants that the plan of qualifying welders is a cost reducer—in other words, that it is really profitable.

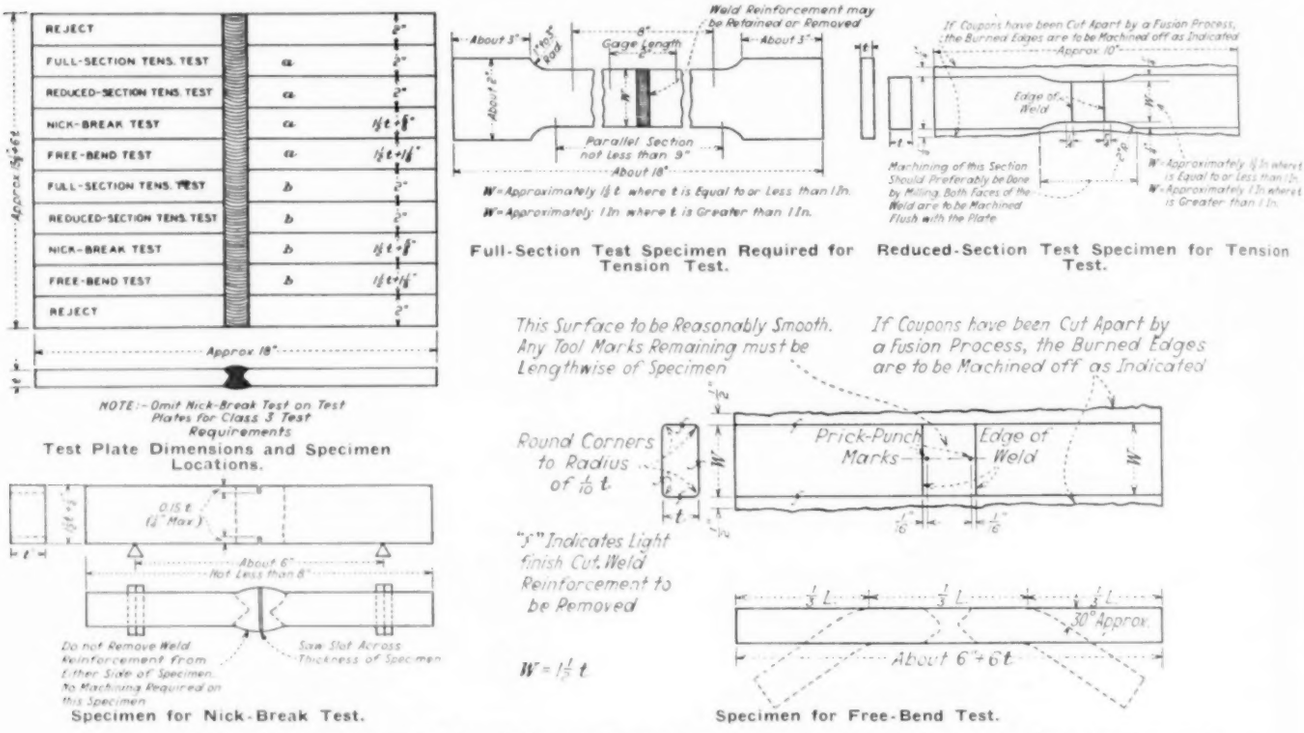

REJECT
FULL-SECTION TENS. TEST
REDUCED-SECTION TENS. TEST
NICK-BREAK TEST
FREE-BEND TEST
FULL-SECTION TENS. TEST
REDUCED-SECTION TENS. TEST
NICK-BREAK TEST
FREE-BEND TEST
REJECT
Approx. 18"
NOTE:- Omit Nick-Break Test on Test Plates for Class 3 Test Requirements
Test Plate Dimensions and Specimen Locations.
Weld Reinforcement may be Retained or Removed
Gage Length
Parallel Section not Less than 9"
About 18"
W=Approximately 1½ t. where t is Equal to or Less than 1 In.
W=Approximately 1 In. where t is Greater than 1 In.
Full-Section Test Specimen Required for Tension Test.
If Coupons have been Cut Apart by a Fusion Process, the Burned Edges are to be Machined off as Indicated
Approx. 10"
Edge of Weld
Machining of this Section Should Preferably be Done by Milling. Both Faces of the Weld are to be Machined Flush with the Plate
Reduced-Section Test Specimen for Tension Test.
Do not Remove Weld Reinforcement from Other Side of Specimen. No Machining Required on this Specimen
Saw Slot Across Thickness of Specimen
Specimen for Nick-Break Test.
This Surface to be Reasonably Smooth. Any Tool Marks Remaining must be Lengthwise of Specimen
If Coupons have been Cut Apart by a Fusion Process, the Burned Edges are to be Machined off as Indicated
Round Corners to Radius of 1/10 t
Prick-Punch Marks
Edge of Weld
"S" Indicates Light Finish Cut. Weld Reinforcement to be Removed
W = 1½ t
30° Approx.
About 6" + 6 t
Specimen for Free-Bend Test.

Figure 2. Qualification Tests Required for Welders on Class 2 and 3 Pressure Vessels Under the New A.S.M.E. Code.

However, there is no occasion for making such tests unduly expensive. In almost every case it is possible to devise a simple scheme of visual examination of the welder's work which requires very little outlay. This visual inspection is accomplished by having a welder make one weld of reasonable size on the material and as nearly as possible in the same position and under the same conditions which will be encountered on the work for which he is being qualified. This sample weld is then broken through the weld itself by the most convenient method. To be of any value, the procedure must be such as to force the break through the weld metal, because this is the metal which it is desired to study. Any inspector should be able to look at such a fracture and determine from its appearance whether the operator has shown reasonable ability to get complete penetration, thorough fusion and to deposit clean, sound metal in the weld. If the fracture discloses a serious lack of ability to do this, it is obviously unnecessary to proceed with any laboratory test involving more expense until the operator has improved his technique to the point where he can make a satisfactory showing in this respect.

After the visual inspection has shown reasonably good ability or even exceptional ability to deposit weld metal which looks good, it becomes necessary in many cases to find out just how good the weld is. In other words, its strength must be measured. Just how this shall be done depends on the kind of work which the operator is expected to do. A specimen is made up for test to destruction, duplicating as nearly as practicable the conditions of the actual work and a test is made of tensile strength and ductility, hardness, corrosion resistance, etc. In some forms of small tank work, it may be suggested to have a welder weld a complete tank and then test it with hydrostatic pressure for tightness. On a production job, involving very large tanks, this would, of course, be out of the question. For most applications, it is desirable to have some sort of quantitative test, of which a permanent record can be made showing just how strong a weld the operator has been able to produce. Such a test involves the making of a weld from which can be obtained coupons of the proper size for pulling in tensile testing machines. If the shop does not have such equipment, coupons can be sent to a testing laboratory. Ductility can be measured by means of the bend test and requires no more equipment than a vise and a finely calibrated flexible rule. Laboratory tests are required for hardness measurements and corrosion resistance can be determined by immersion in a suitable etching solution.

Referring now to the visual examination of welds, Fig. 1, shows several methods of accomplishing this. Fig. 1 A shows the principle of the nick-break test. In this case the coupon is nicked on both sides with a hack saw, so that it can be broken clear through the center of the weld. Fig. 1 B is a lap weld made so that it can be pried apart with a wedge and forces the break in the weld itself. Fig. 1 C is another method of making a lap weld so that it can be readily broken. In this case the ends of the two plates are supported and force is exerted directly over the weld so as to tear it apart. Fig. 1 B is a butt weld specimen held in the jaws of a vise and broken by a blow from the reverse side. Fig. 1 E is another type of fillet weld welded on one side only, which can be broken by a sharp

blow delivered on the reverse side. Structural shapes could be substituted for plate very readily in this test. These five examples alone can be made to apply to quite a large number of welding operations.

The information gained from a visual inspection of the weld metal is well worth the small cost involved. Not only would it be well worth while for every employer to go as far as this in the matter of checking up the ability of his welders, but it would be good for welders to check their own work in this way. It is really a reliable indication of workmanship. It can be done with scrap material and with a minimum of time. Whether additional tests are required depends on the nature of the work and the good judgment of the man in charge.

By studying qualification tests which have already been put into use in different classes of welding some idea of the possibilities of securing close control over workmanship at low cost may be gained.

It must be remembered that many large production welding plants, who have been studying this problem for years, have solved it in their own way. They have supervisors who are able to pick out the good operator quickly. When a new man is hired he may be put directly to work on production and allowed to weld one complete unit for test. If the test is satisfactory he gets a job. After that he is probably on par with all of the other welders in the plant as long as routine inspection methods show no defects. If, however, such a plant should undertake to produce welded articles covered by codes, each operator would be obliged to go through the qualifying test outlined in such codes.

Among the qualification tests called for by code requirements perhaps the most interesting one at the present time is the one specified in the A. S. M. E. Boiler Code for operators welding on Class 2 and Class 3 unfired pressure vessels. The code requires that each operator shall make two test plates, one of a thickness of $\frac{5}{8}$ in. and the other of $1\frac{1}{2}$ in. The completed test plates are approximately 18 in. sq. This allows cutting away 2 in. from each end of the weld, which is thrown away, and leaves enough material to make 2 tensile test coupons of full section, 2 tensile test coupons of reduced section, 2 coupons for the nick-break test and 2 coupons for free-bend test. Fig. 2 shows the complete details of the test plates and the individual specimens. Where the maximum thickness employed in construction is greater than the limit indicated above, test plates of the maximum thickness, if desired, may be substituted for the $1\frac{1}{2}$ in. test plates, and where the test requirements are for thicknesses less than $\frac{5}{8}$ in. a test plate of $\frac{1}{4}$ in. thickness is specified. The type of joint for these test requirements is a double welded butt joint. It will be noted that this series of tests takes care of the visual inspection. (The nick-break test does this) the tensile strength of the weld as compared to the base metal, the tensile strength of the weld metal, itself, and the ductility of the weld metal. The qualification tests for operators welding Class 3 pressure vessels are very much the same as for Class 2 vessels, with the exception that the nick-break test is not required and the thicknesses specified are $\frac{1}{4}$ in. and $\frac{5}{8}$ in. and the type of joint used is a single welded butt joint for $\frac{1}{4}$ in. material and a double welded butt joint for plates having a thickness greater than $\frac{1}{4}$ in. This qualification test is a very rigid one and is, of course, required for work where strength and soundness are very important.

A qualification test for pipe line welders is outlined in the 1928 report of the Subcommittee on Pipe Joints of the American Gas Association. Here it is stated that the test should duplicate, as far as practicable, the conditions encountered in welding field joints. Two short sections at least 8 in. long and of the largest diameter pipe to be used are beveled and set up for welding. The welder is required to make a complete circumferential weld, rotating the pipe during the operation, under the observation of the inspector or supervisor who is to check both workmanship and time. If position welds are required on the job, the welder is to qualify by making the joint without rotating the pipe. In this case the weld is started at the bottom and brought up to the top, then re-started at the bottom and brought to the top on the other side. Strips at least $1\frac{1}{2}$ in. wide and not less than 8 in. long are cut from the completed weld sections. One of these strips,

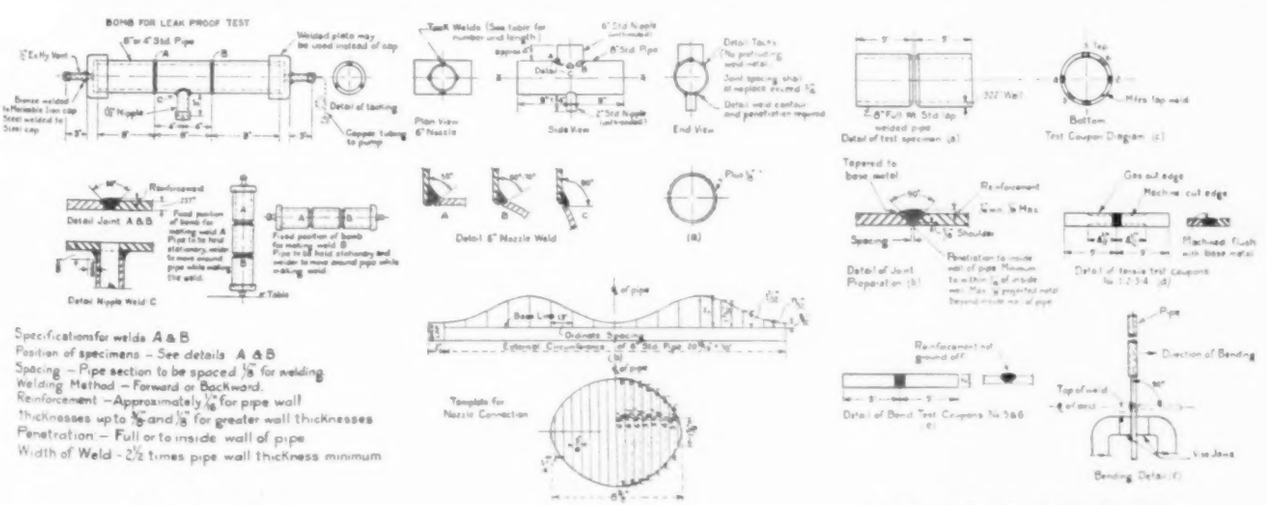

BOMB FOR LEAK PROOF TEST
Detail Joint A & B
Detail Nipple Weld C
Specifications for welds A & B
Position of specimens – See details A & B
Spacing – Pipe section to be spaced ⅛" for welding
Welding Method – Forward or Backward.
Reinforcement – Approximately 1/16" for pipe wall thicknesses up to ⅝" and 1/8" for greater wall thicknesses
Penetration – Full or to inside wall of pipe
Width of Weld - 2½ times pipe wall thickness minimum
Detail 6" Nozzle Weld
Template for Nozzle Connection
Detail of test specimen (a)
Bottom
Detail of Joint Preparation (b)
Detail of Bend Test Coupons No 5 & 6 (c)
Direction of Bending
Bending Detail (f)
Leak Proof Test.
Layout Test.
Bend and Tensile Strength Test.

Figure 3. Qualification Tests for Pipe Welders Recommended by the Heating and Piping Contractors' National Association.

including the finishing point of the joint, is tested by clamping the specimen in a vise with the weld flush with the jaws and hammered against the side from which the weld was made until the piece is bent through 90 degrees. A satisfactory test specimen should not fracture under this test. The specimen is then reversed and hammered

from the opposite side until it breaks. Then a check is made of penetration, fusion, gas pockets, slag inclusions or other defects. It is indicated that it is desirable to cut out tensile test coupons, if practicable, and pull in a tensile testing machine and that such specimens should show a strength of not less than 45,000 lbs. per sq. in.

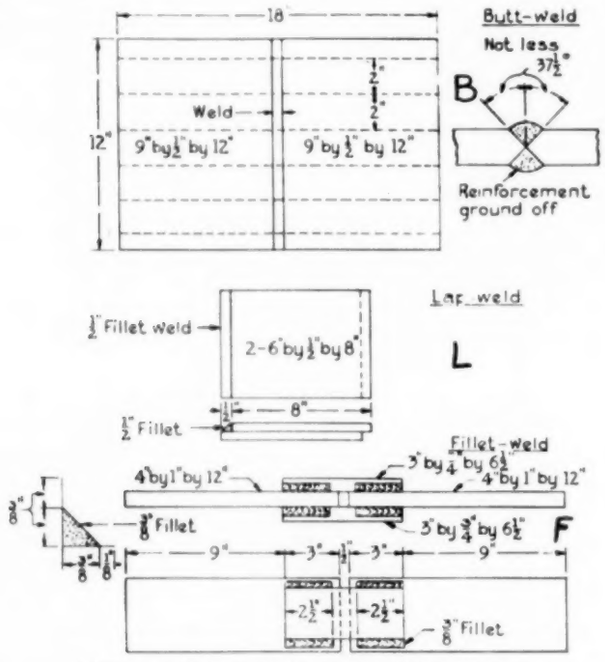


Figure 4. Welded Plates for Qualifying Welders.

The Butt-Welded Specimens at the Top Are to Be Cut into Tension Test Strips Two Inches Wide. The Fillet Welded Specimens at the Bottom Are to Be Tested in Tension to Determine the Longitudinal Shearing Strength of the Fillets.

Qualification tests for building piping are given in the Standard Manual on Pipe Welding prepared by the Heating and Piping Contractors National Association. Here it is recommended that several tests be made including a leak proof test, a lay-out test and a bend and tensile strength test. These are all illustrated in Fig. 3. The leak proof test consists in making a test coupon of 4 in. or 6 in. pipe size with a 1½ in. nipple welded in the pipe in an overhead position. One of the circumferential welds indicated is to be made with the pipe in a vertical position and the other with the pipe in a horizontal position. The pipe is subjected to a water pressure test of 300 lbs. per sq. in., at which pressure all the welds are hammered with a 2 to 3 lb. hammer.

In the layout test the welder demonstrates his ability to layout and fabricate fittings by laying out and fabricating a 6 in. and 2 in. nozzle connection to an 8 in. header, templates being provided. The welder transfers the template profile to the different pipe sections and does the necessary cutting and beveling, then tacks the nozzle connections into position and completes the job.

For the bend test, the two sections of 8 in. pipe, each 9 in. long, are prepared for welding and welded in a fixed horizontal position. Coupons 2 in. wide are removed by cutting, one coupon being taken from the bottom, one from each side and one from the top. The two coupons taken from the sides are clamped in a vise and bent as shown in the diagram, around an angle of not less than 90 degrees without showing any visible defects or cracks in the weld metal. Coupons cut from the top and bottom are tested by clamping the coupons in a vise flush with the jaws and sledging against the side from which the weld was made until the piece is bent through approximately 90 degrees. The specimen is then reversed and hammered from the opposite direction until fracture occurs, allowing examination of the soundness of the weld metal and of the penetration. For the tensile test, two sections of 6 in. or 8 in. standard pipe are prepared in a similar manner as for the bend test and standard test coupons cut out, one from the bottom, one from each side and one from the top or finishing point. Under test, coupons are expected to break outside of the joint, or if in the weld to develop an average strength of not less than 45,000 lbs. per sq. in., and a minimum of 40,000 lbs. per sq. in. for any coupon in lieu of 4 tests.

Qualification tests for welders on structural steel were shown to be of great value in the report of the Structural Steel Welding Committee. In the performance of its initial investigation, this committee made out a qualification test which is described in detail in the report of the committee and which has served as a guide in a number of recent structural welding operations. The test used for the qualification of operators on the 19 floor welded building erected in Dallas, Tex. in 1930, was described by F. P. McKibben in the March, 1931, issue of THE WELDING ENGINEER as follows: See Fig. 4.

These qualifying tests to determine competency consist of three types, lap welds, designated "L;" butt welds, "B," and fillet welds, "F." These three types are presented as follows in the order in which the specimens should be prepared, and if possible, tested.

Lap Welds "L": Each welder is required to make two specimens, each consisting of two 6 in. x ½ in. x 8 in plates with their 6 in. edges offset ½ in. These plates are clamped together and welded by hand along the 6 in. dimension. Upon cooling, the plates are broken by wedging at the free ends, and the broken welds examined for proper fusion with both plates; for density and texture of weld metal; for good penetration into right angle corner of the fillet; for freedom from gas holes, slag inclusions and other defects.

It is scarcely necessary to add that when the plates are broken apart a good weld will break through the throat or minimum section, leaving a portion of the weld metal adhering to each plate throughout the entire 6 in. distance.

This test is so simple that it is given first and if a welder cannot meet these requirements he should not be permitted to proceed with the other tests.

Butt Welds "B": Two specimens, each consisting of two 9 in. x ½ x 1 ft. 0 in. plates are butt welded with a double Vee joint, one welded horizontally, the other vertically. After the weld reinforcement is removed by grinding or machining till the weld is reduced to the thickness of the plate, at least 4 and preferably 5 test strips each 2 in. wide are cut from each specimen and tested in tension. The average tensile strength of each group of the two sample plates should be not less than 45,000 lb. per sq. in.; and the tensile strength of the lowest in each group not less than 40,000 lb. per sq. in.

Fillet Welds "F": Each welder is required to make at least two samples as shown at "F," Figure 4, one specimen welded horizontally, the other vertically. On each side of the splice are a total of 10 in. of ⅜ in. fillet. In fairness to all parties concerned the welding

inspector should insist that the fillets be ⅜ in. and each 2½ in. length as shown. The 2½ in. dimension is made small to accommodate the testing facilities of the ordinary laboratory, but as a variation in length of a small amount may constitute a considerable percentage, the length of the fillet should be as near 2½ in. as is possible to secure. Moreover, although in general it is best on the building to leave the craters normal, that is, not filled, in making these fillet specimens "F," for sake of standardization each crater should be filled to the full section of the ⅜ in. fillet, and the 2½ in. dimension should include the filled crater. These specimens are tested in a tension machine, thus subjecting the welds to longitudinal shear, the ultimate value of which is a measure of the welder's ability. The two specimens should average a total pull of at least 117,000 lb. corresponding to 44,000 lb. per sq. in., or 11,700 lb. per linear inch shearing value of the minimum or throat section of the weld; and the lowest value of the two should be not less than 101,100 lb. total pull corresponding to 38,000 lb. per sq. in. or 10,110 lb. per lineal inch of fillet. The lowest figures, 38,000, is so small that welders whose minimum value do not at least reach that amount should be rejected.

An entirely different kind of a test program is necessary when selecting welders for work on tubular structures, such as aircraft work. A qualification test for aircraft welders developed by the Air Corps at Wright Field consists of the production of four types of joints as illustrated in Fig. 5. The first of these is a single vee butt weld made with a single reinforcement. The reinforcement is machined off and the sample is cut up into test specimens having a test section of ¾ in. width. A minimum of 5 specimens from each sample is recommended. An average strength of 50,000 lbs. per sq. in.

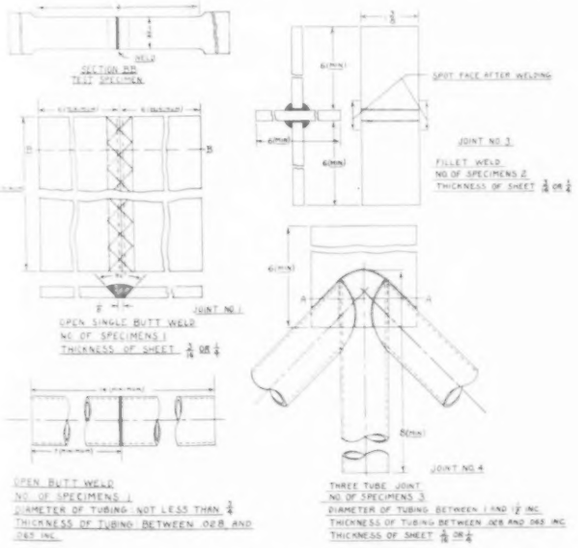

SECTION AB
TEST SPECIMEN
JOINT NO 1
OPEN SINGLE BUTT WELD
NO OF SPECIMENS 1
THICKNESS OF SHEET
OPEN BUTT WELD
NO OF SPECIMENS 1
DIAMETER OF TUBING NOT LESS THAN
THICKNESS OF TUBING BETWEEN .028 AND .065 INC
SPOT FACE AFTER WELDING
JOINT NO 3
FILLET WELD
NO OF SPECIMENS 2
THICKNESS OF SHEET
JOINT NO 4
THREE TUBE JOINT
NO OF SPECIMENS 3
DIAMETER OF TUBING BETWEEN 1 AND 1½ INC
THICKNESS OF TUBING BETWEEN .028 AND .065 INC
THICKNESS OF SHEET

Figure 5. Qualification Test for Aircraft Welders Developed by Air Corps at Wright Field.

in plain carbon steel, and 70,000 lbs. per sq. in. for alloy steel and a minimum of 10 per cent below these values is indicated. The second specimen suggested is an open butt weld made with tubes in a horizontal position for one specimen and in a vertical position for a second specimen. Recommendation is that one set of the horizontal and vertical specimens be welded on a bench and a second specimen welded in an overhead position, not higher than the welder's eyes, the overhead specimen not to be rotated. These joints shall be tested as tensile specimens with reinforcement left intact. The indicated requirement is 50,000 lbs. per sq. in. for mild steel and 80,000 lbs. per sq. in. for alloy steel, based on the area of the base metal. The third type of joint is vertical fillet weld. This is made with the sheet standing on one edge, the piece being supported so that there is a clearance between the lower end of the seam and the jig. It is indicated that this joint should develop not less than 15,000 lbs. per sq. in. The fourth type of joint is a combination sheet and tube fillet weld. When this is tested in tension the indicated requirement is 25,000 lbs. per sq. in. of welded seam between the tube and the weld. It is further recommended that the specimen be cut at the section A-A, polished and etched so as to show whether or not satisfactory penetration has been secured.

It is obvious that no single set of tests can be made to fit all production requirements. It is equally important to note that in many cases a simple, inexpensive, visual test will go a long way toward indicating the welder's ability. All of the tests described above are for steel welding. Where more expensive materials, than steel, are used it becomes still more important to keep inefficient welders off the job by means of qualification tests because the possible loss through spoilage is greater.

W. F. Stoody Advocates Change to Metric System

In a current issue of *Fusion Facts*, W. F. Stoody of the Stoody Company, Whittier, California, advocates an immediate move to make the Metric system of measurements compulsory in the United States, pointing out that the change would have immense practical value in the future and would have the immediate result of furnishing employment for many thousands of people. The Metric system is now obligatory in many parts of the world and its use is legalized by other nations including Great Britain and the United States. "Your first thought," says Mr. Stoody, "is that if the Metric system was made compulsory in the United States, it would only mean a little work in changing over scales and measuring sticks and changing measures of volume. But if you think for a few minutes, you realize that there is not an industry or an individual in the United States that would not have to go to some expense. There is not an industry or individual in the United States that would not profit in a saving of time by its use, and it would permit us to manufacture articles for export, on a production basis, that were of a size and capacity and weight to conform to the standards of most of the rest of the world."

"Anyone who has had experience in figuring capacities of tanks or vessels of any kind can readily see that with the Metric system, he can do practically all of his figuring mentally in so far as capacity is concerned and, knowing the specific gravity of the material in the vessel, can mentally convert his figures of capacity into those of weight. If lumber is selling at $35.00 per thousand square feet and we buy a certain number of boards ten inches wide and twelve feet long, we have to take a pencil

and paper and figure it up because our area is calculated by the duo-decimal system and we buy it with money based on the decimal system."

"It is necessary at present for every machine shop and factory to have conversion tables in order to correlate decimals of an inch into fractions of an inch. The Metric system entirely does away with this."

"Eventually this country will change over to the Metric system. Every chemical laboratory in the United States uses the Metric system, and all electrical measurements are Metric. Optical calculations, the light waves of the spectrum, etc., etc., are all designated by the Metric system; in fact, it would be almost an impossibility in this day and age for a laboratory or for any scientific research to make any progress whatever without the Metric system. If it is so indispensable to them, why wouldn't the rest of the people and industries be benefited as much?"

"If this country were to make the Metric system compulsory it would take about ten million of the now unemployed men at least a year to get things in shape to make the change and another year to catch up the loose ends and make the change complete. There isn't any kind of machine tool in the country but that would have to be changed to some extent. To mention a few of them—every lathe would have to have its lead screw and some of the gears and feeds changed, milling machine cutters, drills, taps, dies, etc., would all have to be changed to conform to the new standard. Blueprints, books, formulas, etc., would be revised and reprinted. Steel shapes, bars and plate sizes would be changed and the machinery for making them changed as would be pipe size, and thread cutting tools, bolts, nuts; in fact, everything that is now 'standard' in length, area, capacity or weight would eventually be changed to conform to new standards that would be simpler and would be more versatile in their use. We would have a chance to get rid of a lot of 'standards' that are not standard but are peculiar to a locality or to an industry."

"A good illustration of some of our 'standards' is the various wire gages and sheet metal gages. The manufacturers of sheet metal and wire could save millions of dollars per year if they just had to make enough sizes to conform to one 'standard' instead of having to make a complete number of sizes to conform to about fifteen different gages."

"Many may think that it would take quite a period of time to become familiar with the Metric system, but it is so simple that in two weeks' time the average person could be more conversant with it than he is at present with our own highly complicated jumble of 'systems'."

The Spur of "Bad Times"

By W. R. Angell†

Bad times are good times for the development of new ideas, improved methods and new business. When things are slack, opportunity is afforded for work in the laboratory of the brain and the laboratory in the factory and the research department is put on its mettle. Bad times are also good times to take a mental inventory of everything pertaining to one's business, to study the lesson that experience should have taught and to take a look into the future as far as our too-limited human intelligence will permit.

With Continental Motors Corporation the slump in business has meant more work for everyone who has to do with new business, methods of manufacture, new devices or management. While outside activities necessarily have been curtailed, there has been a speeding-up inside our walls and in the near future we shall expect to give the public the benefit of our persistent effort to develop something that not only is new but possibly revolutionary.

We observe the same extra-activity in others. More new devices pertaining to automotive engines and vehicles are being submitted to us than ever before. Everyone seems to appreciate the desirability if not the necessity of offering something radically different—something that will have an added appeal. Ceaseless efforts along this line are everywhere in evidence. The results are appearing and will continue to do so for as "Necessity is the mother of invention," so are bad times the fore-runner of new products and increased business.

†*President, Continental Motors Corporation.*

Iowa Welders Exchange Views at Welding Conference

"Bronze welding has had a most important part in the reduction of our installation and maintenance costs," stated Mr. W. G. Coon, of the Iowa Railway & Light Company, in the opening paper of the Welding Conference, held at Iowa State College, Ames, Iowa, January 20, 21 and 22. "On a gas distribution system which necessitated the use of 81,000 feet of 2, 3 and 4-in. pipe in the mains and an additional 45,000 feet of 2-in. land pipe for the service lines, almost as much bronze was used as welding rod on the system of the mains proper."

It is the practice of the company, in running service lines to the consumer's houses, to connect all pipe with recessed couplings and then bronze weld these couplings to the pipe. The pipe is bronzed onto the main by the use of a specially constructed tee which is fabricated with a welding torch. Bronze is used so extensively because it enables the connecting of the service lines to the mains which are under pressure. If an attempt were made to weld the service tees to the mains under pressure, a blow hole, which would be a source of trouble, would be produced when the pipe metal reached the flow point.

During construction, a system is kept under 100 pounds air pressure and tested for leaks. As this pressure is many times higher than the working pressures, a high factor of safety and a tight and permanent joint is assured. Such a system, with the absence of all screwed fittings, makes the probability of leaks very remote. Bronze welding proves invaluable in the repair of old gas distribution systems. On all screwed pipe systems there is a large unaccounted for loss of gas, a greater part of which must be attributed to leaks. All leaks found in the old systems are bronze welded to insure against continued leakage. The use of bronze welding has materially reduced installation costs and eliminated all unnecessary losses of gas, thus decidedly lowering operating costs and enabling the company to give the consumer a more dependable and less expensive service.

Aluminum Increases the Pay Load

By W. E. Archer

How light weight truck tanks are designed, laid out, fitted up, and welded in a Pacific Coast factory.

THE construction of all-welded aluminum gasoline truck tanks is quite rapidly developing on the Pacific Coast. About a year ago the first unit of this type of tank ever constructed in this western territory was fabricated and manufactured by the American Pipe & Steel Corp., Ltd., of Alhambra, Cal. Recently this company completed the construction of two of these units consisting of one truck tank and a trailer tank, mounted on new truck and body ready for service. The welding in the construction of these aluminum tanks was practically all by oxy-hydrogen process.

The length of these tanks is fifteen feet and three inches. Width is seven feet and eleven inches, and the depth four feet and seven inches, making them oval in shape as noted. The combined capacity of the two tanks is a little over 7,000 gallons.

Construction of the tanks is of ¼-inch 2S4 half hard aluminum plate. In their construction, the tanks are fabricated and assembled in four sections, which provides for the installation of three circumferential dividing plates termed "baffles." These plates, the function of which is to control, as much as possible, and prevent the lurching and surging of the fluid load in stopping and starting of the truck, and while traveling over rough roads, etc., are inserted and secured at the seam where the sections of the tank are joined together. A ¾-inch lap weld at the joint completes the joining of the sections and also holds the baffle plate securely in place. These baffle plates, it might be added, were of flanged edges and made for close fitting inside the end of the sections as they were assembled, a separate weld being made to hold it in place before the main joining lap weld was made. One and one-half inch flanged plates were also used for the ends of the tanks, this being generally considered the best method of construction for strength and durability.

Longitudinal plates running the full length of the tank and extending to within three inches of the bottom, termed "surge plates" were secured inside by means of "clips" composed of channel and angle aluminum welded to the inside of the tank. These clips were of three-inch channel and ¼x3x3-inch angle aluminum of 17ST, Heat Treated Duralumin grade, and were welded with five per cent silicon alloy rods. The channel "clips" were welded to the tank, and the angle pieces attached to the channel, to which the "surge plates" were in turn also attached. This operation alone was the only one in the construction of the tanks which was not welded, the plates being secured by bolting. For added strength and rigidness of these "surge plates," the bottom, or free, edges were bent to a one inch flange. These plates are of the same material as the main part of the tank except that they are three-sixteenths inch in thickness. They serve much the same purpose as the circumferential, or "baffle" plates.

Some difficulty was encountered in handling the problems of expansion and contraction in the welding operations on these tanks, and much valuable data and experience was obtained by the manufacturers in their early experimental work in that connection.

The plates were prepared for welding by notching with a cold chisel about one-eighth inch deep and were cut about every one-fourth inch along the edge to be welded. This procedure is generally considered a good one in that it permits the heat of the welding flame to pass through more quickly to the other side of the plate, thus preventing the possibility of "burning"—or at least reducing this to a minimum. Notching also is conducive to better fusion and provides a better means of the weld clearing itself of scale. The edges were not beveled, this being deemed not necessary for this thickness of metal. The longitudinal seams were first tack welded with strong welds about two inches long and about eight to ten inches apart. These seams were butt welded. Circumferential seams were lap welded after first being strongly tacked about every 15 to 18 inches. Welding was all done from the outside, one "fusing in," or penetrating weld being first applied, followed with the second reinforcing or finishing weld. A comparatively smooth job was obtained in the finishing weld which required no grinding. Owing to the oval shape of the tank, placing it on rollers (for convenience in weld-

ing) was not necessary. Instead, rotating and handling was accomplished by means of a rope and hoist.

Quarter-inch and three-sixteenths inch flux coated pure aluminum wire rods were used, the flux being freshly mixed at the plant and the rods dipped immediately preceding the welding operation. This process of applying

A Completed Welded Tank Ready to Haul a Bigger Pay Load.

the flux is universally accepted as being more advisable from the standpoint of welding technique. Also, it is more economical in that less flux is used in dipping the rods than in painting the seam to be welded. The rods mentioned in this paragraph were the ones used in the welding of the main plate work on the tanks. Special rods as mentioned earlier in this article were used in welding the "clips" for holding the "surge plates" in place inside the tank, this being necessitated by the special material used in the clips.

After all welding operations on the tank were completed, a thorough washing was necessary for the removal of all flux from the surface and around the welded seams. This operation was one of great importance, as the flux if not completely removed will corrode the tank after it has been placed in service. Flux remaining on the welded seam will also cause paint to blister and peel off. Washing of these tanks was first done with warm water, followed by the thorough scrubbing with a brush of all the welded seams with a five per cent solution of sulphuric acid. After this, the tank was again thoroughly rewashed with warm water.

Much saving in weight is realized in the use of aluminum-built tanks over those of steel construction, and as the limiting factor in the size of trucks etc., in most cases, is the weight allowed by the highway departments in the different states, this saving in dead weight provides a means of increasing the pay load; and thus a larger return on the investment is obtained. It is therefore readily seen that aluminum, because of its light weight, is one of the most economical materials for use in constructing transportation tank units. Especially is this true in view of the ease of welding it.

Comparing the weight of these tanks constructed of aluminum with similar ones built of steel, the company states that truck tanks of this size made of steel were made of $\frac{3}{16}$-inch material, which, compared with the weight of the $\frac{1}{4}$-inch aluminum, shows a saving in weight of approximately 46 per cent. In other words, the weight of the aluminum tank is about 54 per cent of the weight of a steel tank of like size and built for the same service.

These tanks were constructed for the Advance Auto Body Works, of Los Angeles, who in turn had the contract for the construction of the truck bodies and the mounting of the tanks for the Ventura Transportation Corporation. Construction of the tanks was under the supervision of L. P. Welch, Superintendent of the American Pipe & Steel Corporation, with the assistance of W. E. Kelly, foreman in charge of welding.

X-Ray Demonstration Arranged For Chicago Welders

The American Welding Society, Chicago Section, has secured the cooperation of Claude S. Gordon Company of Chicago for the preparation of a unique program for its meeting on Friday evening, April 1. The purpose of this program is to demonstrate to members of the Chicago Section how much an X-Ray examination can tell them about their own work. All those, who are interested, have been invited to bring to the March meeting of the Chicago Section which will be held Friday, March 4, a welded coupon of $\frac{3}{8}$" mild steel plate measuring 5" x 6" over-all with the weld running along the center of the long dimension. No restriction is made as to what process is used but it is specified that the weld must be made from one side only; that reinforcements be ground off one-half the length of the weld and the reinforcement left intact on the remainder.

Between the March and April meetings all of these coupons will be X-Rayed and criticism made of each X-Ray picture. The coupons will then be broken through the weld so as to permit examination of the inside and to secure the findings of the laboratory. All of this material will be brought to the April meeting so that the X-Ray pictures can be discussed and compared with the original specimens. The prints of the X-Ray pictures will then be returned to those who submitted them for examination. Only one coupon will be examined for each individual. The person bringing a coupon to the meeting need not necessarily be the one who makes the weld as an employer would be allowed to bring a coupon welded by one of his welders. The Secretary of the American Welding Society, Chicago Section, at 608 South Dearborn Street, Chicago, has prepared instruction sheets which are available to those who wish to participate in this program.

Welding Conference Planned at Ohio State

Notice has been received that a welding conference will be held at Ohio State University, Columbus, Ohio, on February 25 and 26, the theme of the conference to be the Industrial Applications of Welding. A program of papers and motion pictures is being prepared and arrangements are being made for the exhibits and demonstrations of latest developments in welding equipment and welding materials. This is the only conference of its kind which has been scheduled so far this year for the State of Ohio, and since it is located in the heart of an important industrial area, it is able to serve a large territory. All arrangements are in charge of O. D. Rickley, Director of Engineering Shops, Ohio University, to whom requests for information should be directed.

Fatigue Strength and Strain Relief*

By Charles H. Jennings†

ABSTRACT

This paper covers several series of tests on the fatigue of arc welds and the strain relief of welded structures. Fatigue tests on fillet welds, and machined, not machined, and peened weld metal are discussed and their endurance limits given.

The effect of annealing and welding procedure on the residual stresses obtained in welded structures is discussed. Welding procedure is shown to have an important effect upon the welding strains obtained and proper annealing is shown to reduce welding stresses to within a few thousand lb. per sq. in.

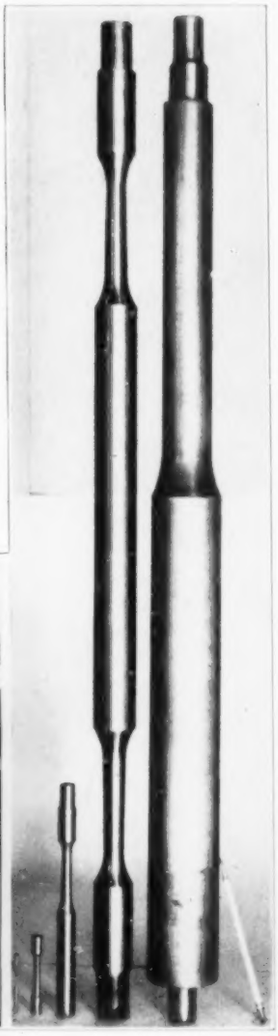


Figure 1. (Left) Large Fatigue Testing Equipment. Figure 2. (Right) Fatigue Specimens for Testing Arc Welds.

THE remarkable success which arc welding received from its early applications to repair work and the fabrication of minor articles rapidly lead to its adoption to structures and machines, subjected to static and dynamic stresses[1], [2].

In connection with the increased application of arc welding, it became necessary to weld heavy materials and to employ complicated connections which often resulted in undesirable residual stresses. The result has been a demand for test data on the fatigue properties of arc welds and the strain relief of welded structures.

Fatigue Tests

Early work on the investigation of the fatigue of arc welds was conducted on butt welds because of their simplicity and adaptability to fatigue tests. Typical test results of butt welds made on low-carbon steel with low-carbon uncoated electrodes as obtained from rotating beam type specimens 0.273 in. in diam. at the critical section are given in Table I.

Table I.
Fatigue Strength of Butt Welds as Obtained From Specimens 0.273 in. in Diam.

Type of Joint	Endurance Limit
30° single vee	21,000 lb/sq. in.
45° single vee	20,000 lb/sq. in.
30° double vee	16,200 lb/sq. in.
45° double vee	17,800 lb/sq. in.

In line with the work on the fatigue of arc welds, the Westinghouse Research Laboratories designed and built a number of large size fatigue testing machines[3]. These testing machines handle specimens 44 in. long and from 1 to 2¼ in. in diameter at the critical section. Figure 1

[1] M. Stone and J. G. Ritter, "Electrically Welded Structures under Dynamic Stress," JI.A.I E.E., March 1930, pp. 202.
[2] A. M. Candy, "Modern Applications of Arc Welding." Symposium on Welding, Pg'h. Rezional Meeting Amer. Soc. Test. Materials, 1931 (separate preprint).

*Paper read before American Welding Society, Chicago Section, Nov. 6, 1931.
†Research Laboratories, Westinghouse Electric and Manufacturing Co., E. Pittsburgh, Pa.

[3] R. E. Peterson, "Fatigue Tests of Large Specimens," Proc. Amer. Soc. Test. Mats., Vol. 29, Part II, pp. 371 (1929).

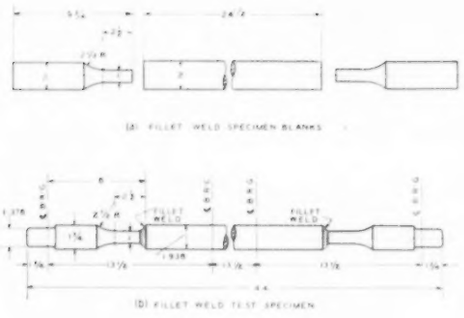


Figure 3.

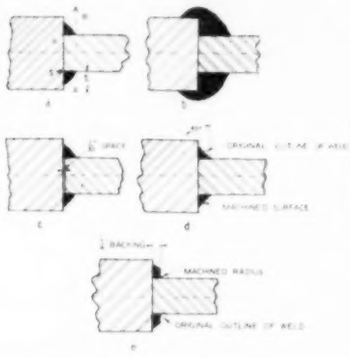


Figure 4. Fillet Weld Types.

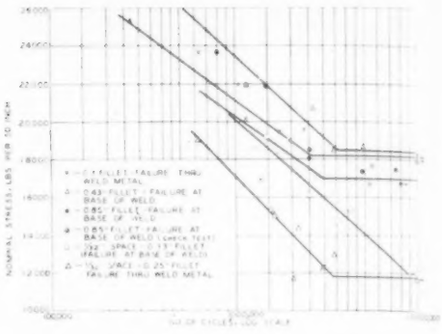


Figure 5. Fillet Weld Endurance Curves.

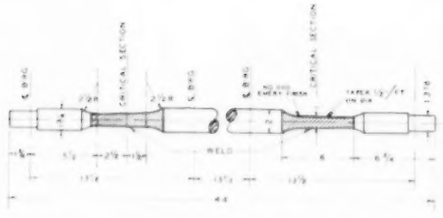


Figure 6. Machined Weld Metal Test Specimen.

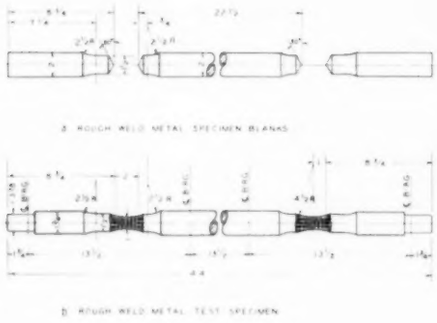


Figure 7.

Figure 8. Critical Sections of Weld Metal Specimens. (Above) Rough, (Below) Peened Weld Metal.

shows a photo of a group of the large size fatigue testing machines. Figure 2 shows a number of the different types and sizes of test specimens that have been used in the study of the fatigue of arc welds.

By means of large size fatigue testing equipment of the above type, it has been possible to investigate several unique welding problems such as: the fatigue strength of fillet welds[4], the fatigue strength of rough (not machined) weld metal[5], and the fatigue strength of peened weld metal[5].

The fillet weld tests were made on double ended rotating cantilever type specimens as shown in Figure 3b. The specimens were prepared from rough machined blanks of hot-rolled, low-carbon steel 2 in. in diameter (see Figure 3a). All welds were made with low-carbon uncoated electrodes.

The specimens were welded by first tacking the blanks together while they were lined up in a jig which consisted essentially of an angle in a horizontal position. After tack welding, the specimens were removed from the jig and the fillets completed with the specimen held in a vertical position. Figure 3b shows a sketch of a completed fillet weld specimen.

The types of fillet welded joints investigated are shown in Figure 4. Endurance curves of some of the tests are shown in Figure 5.

The important data obtained from these tests are as follows:

1. Either of two types of failure occurs in fillet welds: failure through the weld throat or failure through the parent metal at the toe of the fillet.

2. For given dimensions of welded parts, there is a critical size fillet for which failure occurs both ways simultaneously.

3. For weld sizes slightly above the limiting value failure occurs through the parent metal at the toe of the weld (section AA, Figure 4a) developing an endurance limit of about 18,500 lb. per sq. in. For welds much larger than the critical size, failure occurs in the parent metal, but at a slightly reduced endurance limit.

4. For welds smaller than the critical size failure occurs through the weld metal with lower effective strength. Such failures start at the root of the fillet (point S, Figure 4a).

5. Machining a radius at the toe of the fillet (Figure 4e) does not appreciably affect the strength of the weld. Only a slight increase in endurance limit can be expected.

6. The effect of spacing between the welded parts is to greatly reduce the fatigue strength of the weld. For joints of this kind an endurance limit of 12,000 lb. per sq. in. was obtained.

In connection with the above tests on fillet welds, it is important to note that all the stress values given were computed by applying the flexure formula to the 1 in. diameter section at the toe of the fillet (marked A-A, Figure 4a). The stresses computed in this manner are not the theoretically correct stresses because of stress concentrations and different types of failures. As given, however, all results are on a strictly comparative basis.

The lower endurance limit obtained from welds with a space between the welded parts is of great importance from the standpoint of design. The reason for this reduction in strength is undoubtedly due in part to the fact that the section modulus is somewhat reduced by the separation of the welded parts.

In order to thoroughly study the theory of fatigue failure in welds, it was desirable to obtain information on

[4]R. E. Peterson & C. H. Jennings, "Fatigue Tests of Fillet Welds," Proc. Am. Soc. Test. Mat., Vol. 30, Part II, pp. 384 (1930).
[5]R. E. Peterson & C. H. Jennings, "Fatigue Tests of Weld Metal." Presented before Am. Soc. Test. Mat., Annual Meeting, Chicago, June 1931.

weld metal proper. As a result, tests on weld metal were made on 1 in. diameter specimens of the double ended cantilever type. This work included tests on machined weld metal and rough (not machined) weld metal.

The machined type of weld metal specimens were made as shown in Figure 6. With these specimens tests were made on weld metal deposited in three directions: longitudinal, transverse and spiral.

The rough (not machined) type of specimen was developed in order that the affect of machining and peening could be studied. The design of the specimen used is shown in Figure 7. The reduced critical sections of this type of specimen is formed with a large radius thus making the specimen free from stress concentration due to form.

A close-up view of the critical sections of two specimens is shown in Figure 8. A complete specimen mounted in the testing machine is shown in Figure 9. Note that the far end of the specimen has fractured.

The weld metal specimens were all made with $\frac{5}{32}$ in., low-carbon uncoated electrodes using a welding current of approximately 150 amperes. The specimen blanks in all cases were turned from 2 in. diameter hot-rolled, low-carbon steel bars.

In welding the rough weld metal specimens, the end blanks (Figure 7a) were placed on end and a slender column of weld metal 2 in. high built on the point of the machined cone. The three portions that comprise the complete specimen were then lined up in a jig and joined together by welding the built up columns of weld metal to the center bar. All additional beads were laid in a direction parallel to the axes of the specimens. The contour of the complete welds was controlled by means of a template.

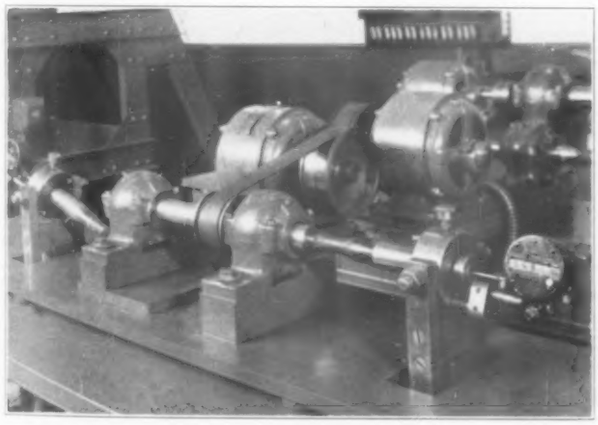


Figure 9. Not-Machined Weld Metal Specimen Mounted in Testing Machine.

The peened specimens were prepared by pounding the deposited beads by means of a light air hammer and a blunt ended peening tool. Some specimens were peened on each layer and some were peened only on the outer layer. A peened weld metal surface is shown in Figure 8b.

Several series of specimens were annealed at temperatures of 1000 deg. F. and 1700 deg. F. for two hours and allowed to cool slowly to room temperature before being removed from the furnace.

The results of the weld metal tests are briefly summarized below. These conclusions will be understood to apply to 1 in. diameter specimens hand welded as previously described.

1. The direction of deposition of the weld metal does not have a large effect on the fatigue strength. The fatigue strength obtained for machined and polished specimens is about 12,400 lb. per sq. in.

2. Rough, not machined weld metal has a higher endurance limit than machined and polished weld metal. The endurance limit obtained from rough (not machined) weld metal is 15,300 lb. per sq. in.

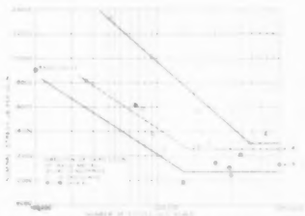


Figure 10. Specimens Having Machined Surface.

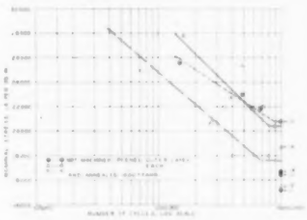


Figure 11. Effect of Peening.

3. Annealing at 1000 deg. F. does not greatly change the fatigue strength of rough (not machined) weld metal.

4. Annealing at 1700 deg. F. for 2 hours results in a coarser grain structure and a lower fatigue strength.

5. Peening each layer of weld metal increases the fatigue strength of rough weld metal. The endurance limit obtained from weld metal peened on each layer is 20,400 lb. per sq. in.

6. Peening the outer layer only is as effective as peening each layer. The endurance limit obtained from weld metal peened only on the outer layer is about 20,800 lb. per sq. in.

Typical endurance curves of weld metal tests are shown in Figures 10 and 11.

From these tests it is seen that the rough (not machined) weld metal, which was supposedly weaker in fatigue than the machined and polished specimens, actually gave higher endurance limits. The only apparent cause for this increased endurance limit is that the machined weld metal surfaces, if examined carefully, show tiny "pin holes" which are not apparent on the rough skin. This would account for a lowering of the endurance limit resulting from machining. These tiny holes seem always to be present in hand-welded metal deposited with uncoated electrodes, but are not as prevalent in automatically welded metal.

This difference between not machined and machined welds is important because in most cases the welds are left in the not-machined state. The increase in fatigue strength obtained by peening is probably in part the result of the cold working of the outer surface of weld metal. A small portion of this increased fatigue strength might also be a result of the smoother contour of the weld surface. The fact that the peening of the inner layers of weld metal did not effect the endurance limit is in accordance with the results expected, because fatigue failure starts on the outer surface and the effect of peening the inner layers is removed by the annealing action of the subsequent layers.

This information on peening is not applicable to fillet welds, since fatigue failure in this case starts at the heel of the fillet and progresses from the inside to the outer surface.

(Continued on page 58)

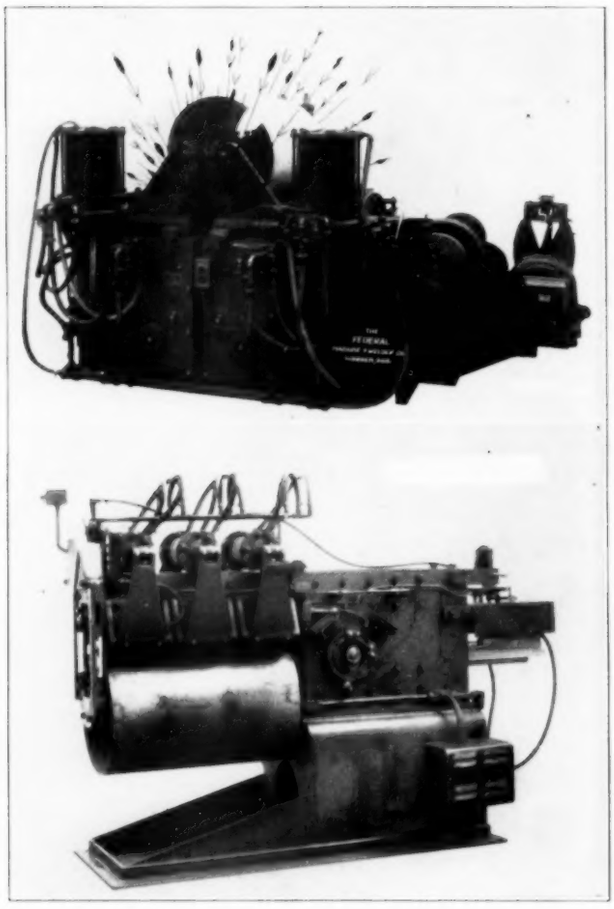


Figure 1 (Above) Barrel Welding Unit Which Turns Out Barrels at the Rate of 100 to 140 per Hour. Figure 2. (Below) Stripper for Removing Flash of the Welding Operation. This Equipment Produces at the Rate of 100 per Hour at a Cost of 2½ Cents per Unit.

The New Resistance Welding*

By M. L. Eckman†

ALTHOUGH much progress has been made in the electric resistance welding field in recent years, the skill of the engineers responsible for improvements has simplified the operations to such an extent that the improvements are most noticeable in the results. To understand what up-to-date resistance welding is we must consider production rates and the quality of welds made by modern equipment.

Mass production was originally made possible by the development of electrical appliances and economical electrical utility service. Special alloy steels are the product of electric furnaces as well as many other non-ferrous metals.

Assembly methods by electrical resistance welding are now available to all manufacturers of metal products, equal in quality, reliability and speed to all previous applications of electrical energy. Excellent quality, high speed and low cost recommend it to any line of manufacture.

Defining a Weld. A weld is a homogeneous uniting of two or more pieces of metal by the application of heat and pressure such as electrical resistance welding, or old-fashioned forge welding or the application of heat and foreign metal such as fusion welding or thermit welding. In order to clearly define the difference between electric fusion welding and electric resistance welding, let us note the chief factors entering into these welds and their results.

Electrical resistance welding is accomplished by heating the entire surface of the abutting edges of the metal to be welded by the resistance of the metal itself to a regulated flow of low voltage, high amperage alternating current. When sufficient heat has been generated, heavy pressure is applied mechanically, completing the weld.

No foreign metal has been added; the entire weld area was heated evenly; therefore, expansion and contraction are uniform, and it is squeezed, kneaded or forged while hot, breaking up the grain structure and making a weld that is comparable to a forging in all its characteristics.

Fusion welding is accomplished by heating the abutting edges to be welded, of necessity in a small area, by action of an electric arc drawn between a carbon or metallic electrode, or the flame of a suitable torch and the work to be welded. Metal is added from a metallic electrode or a filler rod and the heated area is advanced as fast as the fusion will permit until the whole is completely welded. The resulting weld is a miniature casting in several respects. In most cases there is ample strength for the load imposed, but often with expansion and contraction strains tied up in the welds.

Electric resistance welding is divided roughly into three principal classes, namely:

Projection Welding: In principle, a projection welder is a multiple spot welder and the principle is quite old, being patented by A. T. Reitzel in 1912. The patent situation held up development of this for awhile, but patents having now run out, manufacturers are now utilizing projection welding extensively. Projections of a spheroid, conical shape are raised on the metal (usually in a punch press) which, in contact, localizes the flow of

*From a paper read before the Seventh Annual Welding Conference, Purdue University, Lafayette, Ind., Dec. 11, 1931.

†Research Engineer, The Federal Machine and Welder Co., Warren, Ohio.

Skillful development in the field of resistance welding has resulted in machines which turn out welded products of high quality at mass production speeds and with a manufacturing economy which puts many one-time luxury items in the necessity class and within the reach of increasingly larger groups of buyers.

current. These projections, with proper electrical capacity and pressure, enable us to make a great many welds at one time. From 2 to 60 welds are now being commercially handled on projection welders at one time.

It is good practice to make the projections about the thickness of the metal at the base and about 70 per cent of the thickness in height. The outstanding advantages of this method of welding is that several units may be assembled in a suitable locating jig or fixture and all welded by this method at once. It has many applications in automotive and like industries.

It requires large powerful machines to handle projection welding properly, since both electrical and mechanical units must be ample and sturdy. Considerably more energy is required to make two welds by the projection method than by ordinary spot welding. The reason is because of the bucking action set up by the two or more magnetic fields in the weld metal itself.

In general, the capacity required varies with the thickness of the metal and spacing of the projections, and it is hard to set definite specifications or rules for this work. The following table is sort of a rough guide:

1. Spot Welding and Projection Welding.
2. Seam Welding or Continuous Line Welding.
3. Flash Welding and Butt Welding.

Spot welding was for years just an incidental operation in manufacture. Now it has become the backbone of many mass production plants. Consider the following table which tells how many spot welds there are in four common articles:

Automobile bodies	500 to 1500
Electric refrigerators	50 to 150
Electric stoves	25 to 150
Radios	10 to 125

Not one of them could be produced at present prices without modern spot welding equipment.

The next table shows the speed and economy of the method:

Pieces	Material	Size	Throat	Req'd. K.W.	Time	Current Cost per 1000 welds
2	20 Ga.	.0375	12"	3	.5	.01
2	16 Ga.	.0625	12"	7.5	.8	.02
2	11 Ga.	.125	12"	10	1.3	.05
2	7 Ga.	.187	12"	15	2.	.08
2	3 Ga.	.250	12"	20	3.	.15

Originally spot welders were all manually operated by foot or hand power, and many such machines are operating and will continue to operate manually, but wherever high production or uniform quality is desired, power-driven machines are the type to be considered. The power control is an important part of the new resistance welding.

Reasons are that the pressure can be regulated as desired, and once set, is uniform, the timing is exact, the current duration never varies and if these three factors —pressure, time and current—are accurately controlled, the welds will be uniform in quality, speed and economy, provided the points are kept properly serviced.

Spots	Material	Thickness	Welding Area	K.W. Req'd.
5	16 Ga.	.0625	10 sq. in.	60
8	10 Ga.	.140	16 sq. in.	150
10	7 Ga.	.1087	20 sq. in.	175
15	3 Ga.	.250	24 sq. in.	250

The use of projections in mass production of spot welds can therefore be considered as another of the important features of the new resistance welding.

Flash welding is another important contribution to the new resistance welding. The principle is not new, but the trend toward widespread use of flash welders in place of butt welders is rather recent. In this process, an arc is drawn between the two pieces of material to be welded, and this arc is maintained at steady uniform temperature as the pieces advance slowly toward each other, until sufficient heat has been absorbed to make the desired welding condition, when, without any hesitation of the movement of the machine, a powerful upsetting pressure of approximately 6000 lbs. per square inch is applied as quickly as possible and the current is cut off for the first 25 per cent of this upset. This makes what is termed the "Flash Weld," which is more reliable, stronger, has less burr or upset to remove and uses considerably less current than the old-fashioned type of butt weld.

Since the available space does not permit of illustrating all of these developments in detail, a single application will be shown. This is the flash welding of barrels. Fine engineering has produced marvelous results in this field. Figure 1 shows the barrel welder which will weld at the rate of 100 to 140 barrels per hour.

Figure 2 shows the barrel stripper which is used for removing the butt or flash thrown up by the electrical resistance weld. The cost of current, compressed air, and labor to produce one welded barrel is $.0256, or approximately 2½c, at a speed of 100 barrels per hour.

Figure 3. (Left) Drum as It Comes for the Welder with Joint in the Center. Figure 4. (Right) Completed Standard Barrel.

Figure 5. An Unusual Test. A Water-Filled Drum Is Dropped 18 Feet onto an 8x10 Timber.

Figure 6. After the Fall, There Are No Signs of Leaks Despite Considerable Distortion.

Figure 3 shows the drum just as it comes from one of our resistance welders.

Figure 4 shows a standard 55-gallon barrel completed. A 3-in. strip is left unpainted to show the weld line, which is indicated by a fine white line down the center of this strip.

Figure 5 shows an unusual test to which these drums are put. They are filled with water, raised by a crane eighteen feet from the floor, and automatically tipped, allowing them to fall on an 8x10-in. timber placed directly under the center of the barrel, and over which the barrel is dropped, all strain coming on the resistance welded seam. Figure 6 shows the result of such a drop. Note that there are no leaks in the barrel and yet it is considerably distorted.

We might mention at this point that the leading barrel manufacturers of the United States are now equipped with one or more units for producing barrels by the electrical resistance flash welding process.

The sum total of all of our experiences and developments teaches us that electrical resistance welding will inevitably hasten the march of industrial progress. In its modern forms it is inherently a mass production method of unlimited possibilities. Today's machines are delivering speeds and uniform quality which were not dreamed of five years ago.

Georgia Tech. Conference Has Good Attendance

A good attendance was reported at the second annual conference on welding which was held at Georgia School of Technology, Atlanta, Ga., on January 27 and 28. During the two-day program of lectures and demonstrations, the following papers were presented:

The Development of Welding in the Various Piping Fields—
Mark Holt, Chief Welding Engineer, Chattanooga Brazing & Welding Co., Chattanooga, Tenn.

Latest Developments in Fusion Welding—
T. S. Murphy, Assistant Research Engineer, Hedges-Walsh-Weidner Boiler Co., Chattanooga, Tenn.

Welding With Tobin Bronze and Similar Alloys—
Ira T. Hook, Research Engineer, American Brass Company, Ansonia, Conn.

Oxy-Acetylene Process in the Textile Industry—
S. H. Jones, Welding Engineer, Burdett Oxygen Company, Atlanta, Ga.

Address by Roy LeCraw, President, Atlanta Chamber of Commerce.

Moving Talking Picture.

Years Ahead in Arc Welding—
N. H. Hendee, Arc Welding Specialist, General Electric Co.

The Shielded Arc Process and the New A. S. M. E. Boiler Code—
John E. Durstine, Engineer, The Lincoln Electric Co., Cleveland, Ohio.

Application of Arc Welding to Design, Construction and Maintenance—
J. G. Ritter, Designing Engineer, Welding Dept., Westinghouse Electric & Mfg. Co., Pittsburgh, Pa.

Recent Developments in Arc Welding and Its Application to Industry—
L. D. Meeker, Manager of Arc Welding Dept., General Electric Company, Schenectady, N. Y.

The Application of Torch Welding to Aluminum and Its Alloys—
P. T. Teague, Architectural Engineer, Aluminum Company of America, Pittsburgh, Pa.

Theory and Practice of Oxy-Acetylene Cutting—
E. V. David, Mechanical Engineering Dept., Air Reduction Sales Co., New York City.

Lindewelding—a New Method—
William Rierson, Service Supervisor of Welding, Linde Air Products Company, Atlanta, Ga.

How We Can Determine the Strength of, and Can Inspect Welded Joints with Practical Demonstrations—
George Bird, Jr., Chief Engineer, Bird-Potts Co., Atlanta, Ga., and O. M. Harrelson, Welding Engineer, in charge of Welding and Heat Treating Instruction, Georgia School of Technology.

Views of the Exhibit Hall at the Georgia Tech. Conference.

According to report received from R. G. Wilson, District Sales Manager of the Burdett Oxygen Company, this year's conference exceeded the one held in 1931 both in attendance and in the number of exhibitors. He made special mention of the splendid address of M. L. Brittain, President of Georgia School of Technology, who cautioned the audience to give thought to the human side of their work when making progress and pointed out that there is a real lesson today in the story of the Frankenstein monster which would not hesitate to destroy its creator because it had no soul.

During the course of the conference special demonstrations were scheduled as follows: Aluminum Welding by Burdett Oxygen Company, Pipe Welding by Tube Turns, Inc., Automatic Cutting by Air Reduction Sales Company, Arc Welding with High Strength Electrodes by The American Murex Corp., Bronze Welding by the American Brass Company, Hard Facing by the Oxweld Acetylene Company, Shielded Arc Welding by the General Electric Company, Structural Steel Welding with Automatic Eye Shield by the Westinghouse Company.

Economy in Welding Operations*

By E. Lunn†

WELDING is not a device which must be employed as a substitute for other methods of joining metals. Its use is predicated on several factors, among which is a conviction that a change in established practice is due; also, that necessary joint strength in weld metal can be obtained and that economy in the welding operations can be effected. Much has been written concerning the first two, but not so much about the third.

Acceptance of welding in the construction of buildings, bridges, railroad cars, boats and other structures designed for public use, is dependent to a large degree upon the attitude of those who are to be held responsible for the success of the particular undertaking, in which it is proposed to substitute welding for other forms of joint making.

If the newer development is worthy of success, a preponderance of evidence will break down resistance to its progress.

It may be well to here mention some things which should be considered when mapping out an economy program:

Avoid cheap materials, probably having poor weldability; cheap equipment, probably having faulty operating characteristics; cheap welding wire which is the forerunner of slow welding; waste of material; high percentage ot rejects; high inspection cost; cheap help which produces uncertain results; rapid labor turnover; and excessive training cost.

The real way to economy is through engineering control, involving:

Control of Design—Designing for suitable strength so that entire structure will not be too far in excess of normal working strength; designing for the proper amount of welding to insure against rejects by inspector; designing for position of weld so that it will be in the right place to give best service and in position to favor the operator who makes the weld.

Control of Materials—Proper specifications to assure good result and uniformity as to welding quality.

Control of Welding Wire—Selection based upon results secured, with special reference to the effect on total job cost; specifying uniformity, speed, ease of flow, and character of deposit.

Control of Personnel—Through qualification tests, which produce fewer failures, smaller labor turnover, and less inspection cost.

Control of Procedure—Including welding technique, preparation of material, jigs and fixtures, organization of work so that welders are not obliged to set up their work, peening when necessary, and annealing or normalizing when necessary.

Control of Inspection Program—For the purpose of maintaining necessary standards, and minimizing failures.

Where this type of control is lacking, a certain amount of failures are bound to happen. Failure cost includes:

If the volume of economical welded fabrication is to continue to grow, those responsible for its successful use must give constant and thorough consideration to several factors among which are: control of design, materials, welding wire, personnel, welding procedure, and the inspection program. If any factor is slighted and failures occur, there will be resultant losses in raw material, labor, overhead, good will of the customer and trade reputation.

Raw material cost;

Design cost;

Good will of customer;

Trade reputation.

This all amounts to many times the apparent cost of making the weld that failed.

Important among these headings is that of strength of joint.

From start to finish every process employed in handling steel from its native condition to its final appearance in a completed structure is surrounded by restrictions designed to insure that it is provided with definite and known strength as well as with other characteristics. Uncertainties so far as possible, must be eliminated in order to insure correct answers to fabricating problems.

Development in welding has followed much the same course as that of other industries. First the discovery that it was possible to join metals together in a molecular union by an expenditure of energy in the form of heat properly applied to them. Then the further discovery that the heat producing elements could be brought to the metals rather than the metals to the heat. What a simple but significant step that was. Then followed in rapid succession improvement after improvement in welding processes as well as in equipment. The field rapidly broadened until recently it has seemed as though the producers of welding apparatus, the manufacturers of improved filler material, the steel mills, and those engaged in searching for an improved welding technique are racing as if to a goal in an endeavor to reach the ultimate in perfection.

To obtain economy in welding operations, suitable equipment is essential. In many cases this requirement upsets traditions of long standing. To many officials who know welding only by name, a difference in price between the right and wrong size or make of apparatus has more weight than the request of the welding engineer that only the most suitable equipment be bought. Too often inade-

*From a paper read at Purdue University Welding Conference, LaFayette, Ind., Dec. 11, 1931.

†Consulting Engineer, Chicago, Ill.

quate devices are installed, and the error shows up in lessened operating economy.

The same may be said about filler metal. Time was when this commodity was bought on price. That was when questions of quality of weld metal were left to the purchasing agent. Competition was keen and welds were as a rule not placed under strains which stressed them beyond safe limits. The cheaper grades of wire or rods served the purpose so far as weld strength was concerned, but the economy which was anticipated would follow their use did not always materialize.

To complete a welding job and show a profit, or a cost less than would have been incurred by other means of fabrication, is a most desirable achievement; at first it would have been note-worthy; but in the face of present developments it should be a reflection on some branch of an undertaking if the cost is greater. Many factors enter into any job of considerable magnitude, and success or failure is quite likely to depend upon the percentage of unknown factors so far as welding is concerned. A lack of knowledge of only one of the many details involved may turn success into failure. For instance, a carefully and intelligently laid out plan is essential. The designer may not be a welder but he should know the value of welds of the types to be used on the job, and how to indicate them on the drawings. He should know as the poet Carleton wrote, "How much to know and how to not know too much."

The proper use of standard welding nomenclature should be understood by every designing engineer who has to deal with welding. Weldable steel must be specified in order to insure success, and it must be so prepared that welding can be performed under proper conditions. Some one connected with the enterprise with a knowledge of welding wire as well as how and where it is to be used should have the say as to the type to be ordered for the job.

It should be the duty of some one well informed in production methods to lay out the shop work or work in the field, as the case may be. Often the best laid plans go wrong because of failure to arrange benches and jigs in such a manner that an operator can perform his work in a comfortable position. It is with no thought of molly-coddling the operators that it is made possible for them to sit or stand while welding in the most comfortable position possible. That is not only a humane thing to do, but it is conducive to better welding and much more of it with the expenditure of the same effort on the part of the welder. How often do you see photographs taken of welders at work and how often are they shown in any other position than humped over? How long can a welder hold such a position and do good work?

The man who lays out the shop work should have in mind that every time a welder has to take the kink out of his back, legs, or arms it is costing the company money. This is so often overlooked, or disregarded, that special mention should be made of it.

Welding is neither difficult nor exhausting work if it can be performed under conditions conducive to comfort. It can be made exhausting if the operator is compelled to assume an unnatural position and required to work continuously.

Few welders know how their work compares with that of others, and a dissemination of available information among them will show good results. They have their own peculiarities which often result in mediocre welds. Habits formed by repeating a practice which is not quite up to standard will in time become so fixed that they can be corrected only by diligent and painstaking effort in the right direction.

Weld failures should not be tolerated. The cost of such an occurrence may be much greater than that of the time spent in rewelding. The shock to the nervous system is likely to be much more expensive. To effect economies in welding operations, welds must not fail.

Another important item is that of the treatment of welds after they have been completed. A knowledge, on the part of some one connected with the job, of what can be expected to happen from stresses set up as a result of weld shrinkage is essential. Some welds are so placed that the residual stresses left in them and in the adjacent parent metal should be relieved by heat treatment, and others by peening. Sometimes the omission of secondary treatment of welds results in excessive expenditures to correct faults in the completely welded structure. This expense may well come under the heading of "Expenditures resulting from not carrying out the projected plan."

The control of economy in welding operations, therefore, resolves itself into a matter of putting all factors affecting the end result under the control of the engineering department, and guarding against the higher total costs which might result from petty economies realized on one or more of the apparent cost items.

Good Attendance, High Interest at C. G. M. A. Meeting

A good attendance and lively interest was attracted by the nineteenth annual meeting of the Compressed Gas Manufacturers' Association, held on January 25 and 26.

"Development of Containers for Transportation of Gases under Pressure," by E. C. MacQuigg, of Union Carbide and Carbon Research Laboratories, and J. J. Crowe, of Air Reduction Company, and "Containers—their Forms, Formulae and Formation," by Franz Elder, were among the technical papers included in the well-balanced program. These particular presentations covered the development of the industries and their shipping containers with a discussion of the future possibilities in pressure vessel development.

A. Cressy Morrison, past president, and charter member of the organization was elected to honorary membership. At the Tuesday luncheon Mr. Morrison discoursed on the subject of the relations of the association with the regulatory bodies.

The convention was concluded with enjoyable dinner, held at the Hotel New Yorker, which was attended by more than two hundred guests. The speakers were Colonel B. W. Dunn, of the Bureau of Explosives; W. P. Bartel, Director, Bureau of Service, Interstate Commerce Commission; Dr. Clyde Fisher, Curator of Astronomy, Museum of Natural History, and Colonial Dan Edwards. The addresses of Colonel Dunn and Director Bartel covered relations with the regulatory bodies from the viewpoint of the latter and were in the nature of a response to the earlier address of Mr. Morrison.

The following officers for 1932 were elected: President, J. A. Kienle; First Vice-President, F. J. King; Second Vice-President, F. A. Eustis; Secretary, Franklin R. Fetherston.

When a Driveway Had to Be Widened*

The Factors Involved in Transferring a Large Load to a New Column, the Removal of the Old Column and How the Job Was Carried Out

By Frank P. McKibben†

RECENTLY upon completion of the shop-riveted, field-welded fourteen-story addition, which is the sixth section of the DuPont Company's main office building at Wilmington, Delaware, these headquarters covered an entire city block except for some interior open courts. Access to the stage entrance of the DuPont theatre consisted of a narrow passageway leading from Orange Street through the main structure to one of these interior courts; but with the completion of the sixth section, this driveway was too narrow and had to be widened.

This widening involved the removal of that portion of a main building column which extended from the street level to the first floor, leaving the balance of the column to support the roof and the twelve floors from the second to the thirteenth inclusive. The removal of a lower portion of this existing column necessitated the introduction of a double plate girder over the driveway to support the first floor, the girder's own weight, the load transferred to it from the undercut column, as well as that part of the interior court wall directly above the girder. These changes were to be made with as little noise as possible and with no perceptible settlement of the floors, walls and other parts of the building.

Therefore, the problem, succinctly stated, involved the transference of a large load from an existing column to a new girder, removal of the lower story's length of column, the abatement of noise, and avoiding subsidence of existing construction.

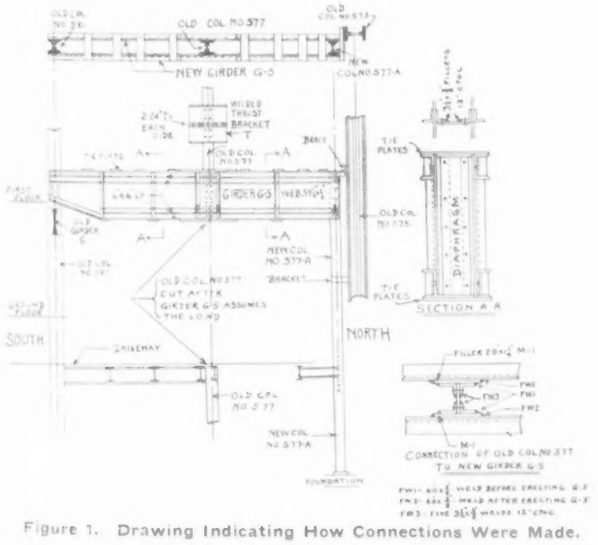


Figure 1. Drawing Indicating How Connections Were Made.

In order to minimize noise, welding aided by bolting, was used in the field work. The girder was shop riveted.

To avoid settlement of the building the girder was given such a predetermined deflection by the use of hydraulic jacks that when the lower portion of the central column was cut away with the oxy-acetylene torch no subsidence in the structure above was perceptible. In other words, the girder was given in advance its full deflection by the jacks (before the column was cut) in such a manner as to transfer gradually the load from column to girder, leaving undisturbed, at their original levels, the various floors, walls and other portions of the building.

Figure 2. How the 460,000-Pound Dead Load Change Was Made.

The girder, consisting of two separate parts each with web and flanges so that a part could be erected on either side of the existing column, had the webs partially removed at its south end, and the lower flanges inclined to avoid interference with an existing girder, G, connecting to existing column No. 581, Fig. 1. The two parts of the girders were later connected by diaphragms between the webs and by tie plates across the flanges.

Connections of the various floor beams to one another and to girders were made by welding or bolting in the usual manner and require no comment.

The following denotes the sequence of main events:

1. Installation of foundation for new column No. 577-A supporting north end of girder G-5; removal of masonry to permit other changes contemplated.

2. New column No. 577-A erected and braced to old column No. 573.

3. The two separate halves of girder G-5 were erected, one on either side of old column No. 577; the two parts were bolted to new column No. 577-A; girder G-5 web diaphragms and flange tie-plates bolted in place.

4. Girder G-5 leveled; holes drilled in column No. 581 to match shop holes in the girder G-5, and girder was

*From a paper read before the American Welding Society, Boston, Sept. 22, 1931.

†Consulting Engineer, Black Gap, Pa.

bolted to column No. 581; new first floor framing was erected and bolted.

5. To secure initial deflection of new main girder G-5 by transferring to it the load of 460,000 lbs. from the existing column No. 577, two thrust brackets, T, Fig. 1, each consisting of two 24 in. 79.9 lb. I beams, were first bolted, then welded to existing column No. 577, with a total of 192 in. of ⅜ in. fillet; after which two hydraulic jacks were inserted on top of girder G-5 and under these thrust brackets, Fig. 2. As pressures were applied to the jacks the girder deflected downward till the deflection with respect to the ground had reached the calculated amount of approximately ¼ in. Wedges were then inserted in the jacks. Two pieces of 4-inch shafting, set between the thrust brackets, T, and the top flanges of girder G-5, were tack welded in place. These precautions were taken to avoid possible motion due to leakage in the jacks.

6. Meantime, braces connecting new column No. 577-A to new girder G-5 and to existing column No. 573 were welded; two fillets each of 36 in. and two of 60 in. each were placed to connect the north end of new girder G-5 to new column No. 577-A; and two fillets of 32 in., and two of 38 in. each, were laid to transfer stress from south end of girder G-5 to existing column No. 581. Field welds FW-1, Fig. 1, were made to connect the column angles to filler plates M-1; and FW-3 to connect these angles to column web.

7. The final steps consisted in drilling, while girder G-5 was thus under deflection, a series of holes through it and column No. 577 to draw the two parts closely for welding; placing four fillets FW-2, each 60 in. by ⅜ in., to connect filler plate M-1 (and hence column No. 577) to girder G-5; then cutting off, with the oxy-acetylene torch, that part of existing column No. 577 extending from the driveway level to the lower side of girder G-5, as well as the projecting ends of thrust brackets T, Fig. 3.

The dead load to be transferred during construction was

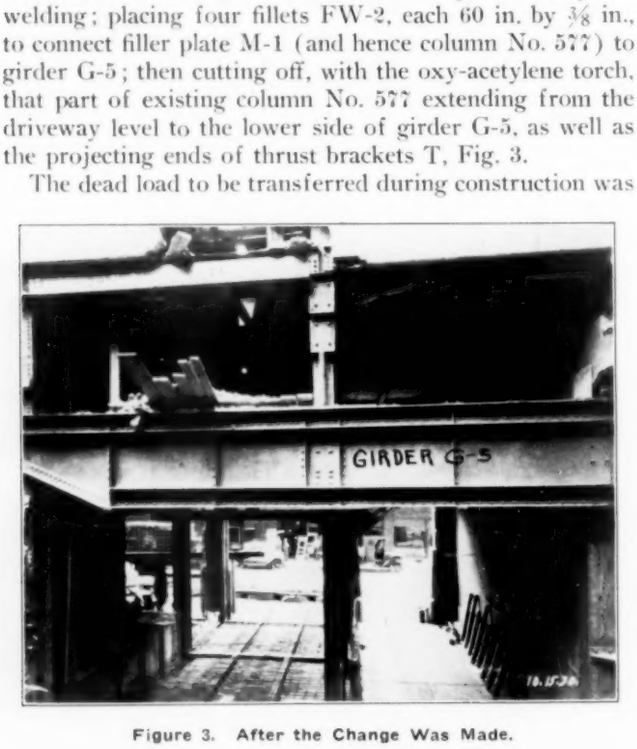


Figure 3. After the Change Was Made.

approximately 460,000 lbs. Provision was made for a possible total live and dead of 500,000 lbs. to pass from column No. 577 to girder G-5.

Deflection of New Main Girder

The ultimate deflection of the girder at column No. 577, after removal of the lower portion of the latter, is composed of two actions; first, deflection within the girder itself due to the load from the column; second, that due to shortening of the supporting columns Nos. 581 and 577-A caused by compression transmitted to them from ends of girder G-5.

The following study illustrates these simple computa-

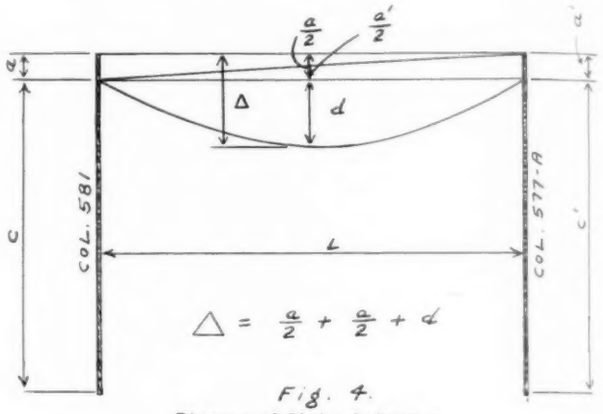


Fig. 4.
Diagram of Girder Deflection.

tions for deflection of the girder at column No. 577; Fig. 4.

P = total load applied by column No. 577 to center of girder G-5 = 460,000 lbs.

A = gross cross-sectional area of column No. 581 = 97.5 sq. in.

c = length of column No. 581 = 400 in.

a = shortening of column No. 581 in inches due to compression of $\frac{P}{2}$ lb.

A^1 = 27.05 sq. in.; c^1 = 400 in.; for column No. 577-A.

a^1 = shortening of column No. 577-A due to compression of $\frac{P}{2}$ lb.

E = modulus of elasticity = 30,000,000.

I = moment of inertia of cross section of girder (assumed constant) = 69,400 inch units.

L = span of girder = 360 in.

△ = deflection of center of girder; due to shortening of columns Nos. 581 and 577-A, and to load of P at the center; = 0.286 in. as found below.

The details follow:

Deflection at center of girder due to P = $d = \frac{PL^3}{48EI}$

Shortening of column No. 581 due to compression of $\frac{P}{2} = a = \frac{Pc}{2AE}$

Shortening of column No. 577-A due to compression of $\frac{P}{2} = a^1 = \frac{Pc^1}{2A^1E}$

Total deflection at center of girder with respect to the earth is

$$\triangle = \frac{a}{2} + \frac{a^1}{2} + \frac{PL^3}{48EI}$$

$$\triangle = \frac{Pc}{4AE} + \frac{Pc^1}{4A^1E} + \frac{PL^3}{48EI}$$

$$= \frac{P}{4E}\left[\frac{c}{A}+\frac{c}{A^1}+\frac{L^3}{121}\right]$$

$$= \frac{460000}{4(30000000)}\left[\frac{400}{97.5}+\frac{400}{27.05}+\frac{(360)^3}{12(69600)}\right]=$$

0.286 in.

The value of 0.286 in. represents the amount of initial central deflection with respect to the earth that should be given the girder.

Structural design by duPont Co. Engineering Department.

Steel and erection by Belmont Iron Works; welding by Mellon, Taylor, Hendrickson, Inc. Carson and Carson and the writer supervised welding and inspection thereof.

Building a Job Welding Business

By W. Irving Brockson

X—Financing the Business

"DON'T start on a shoe string." That is probably the first statement that nine in every ten job welding shop owners would make if they were called on to give advice to a "bright young welder" thinking of starting in business for himself.

The first year a job welding business operates is a most trying and discouraging time. A great deal of money must be put out for equipment, supplies, rents, signs, advertising and other purposes. Furthermore, much of the owner's time must be spent in doing "missionary work" which does not bring in immediate returns. Even though prior to starting the business arrangements were made with several firms for their welding, it is not likely that the work from these sources will be sufficient to keep the shop on a profitable basis. Other customers must be obtained. With respect to the finances during this early period, some one has well said: "It is all going out and little coming in."

Before starting his own business, the chances are the job welder was employed by a large manufacturing concern, a railroad, a power company, or another job welding outfit and received wages or a salary at regular intervals. He had a definite income which he could depend on and could plan his expenses accordingly. But just as soon as he starts to operate an establishment of his own, all this is changed. His income is uncertain and arrives at irregular intervals and his expenses increase greatly.

The First Months Are Usually Discouraging. Because of the necessary large outlays of money required at the start and the likelihood of meagre income during the first weeks and months, it is highly essential that the operator have saved up a "tidy sum" before going "on his own." During these treacherous beginning months, if the business has been started largely on borrowed capital, it is under the double handicap of not making sufficient money to pay current bills but also of piling interest charges on the money borrowed. Under conditions like this many men become so discouraged that they are not able to do their best work on the few welding jobs they do receive or on the project of soliciting new business. It is true that by entering business for oneself there are opportunities to make far more money than one can on a salary, but there are also hazards and possibilities of failure.

Now, let us assume that the "bright young welder" has sufficient capital to buy his equipment and initial supplies, pay his operating expenses for a few months and to take care of his personal and family requirements. What are some of the factors from a money or financial standpoint should he give attention?

Relations with the Banker

Every business worthy of the name needs a bank account and the advice and counsel of a good banker. A banker can be of assistance not only in the matter of providing facilities for paying bills by check, but also in the way of lending money for expansion, providing safety deposit boxes for valuables, giving credit information about prospects, answering inquiries about your own credit rating, giving advice on general business policies, making suggestions on methods of investing surplus, and offering trained judgment regarding the business outlook at various times. Consequently, one of the first things the job welding shop owner should do after he starts in business, and preferably before, is to pick out the best banker he can find in his territory, open an account in his bank, cultivate his acquaintance and get his ideas on building welding shop trade.

It will pay to be perfectly frank and "above board" with your banker. Your relations with him are confidential, and even though later on he may be called on by some one else to give information about you he will report only in general terms and will not reveal confidential information. If you "come clean" with him you will convince him of your honesty and sincerity and will put him in a position to give you at least a good character record if called upon to do so. If you try to "cover up some dead horses" in the way of past financial difficulties, or if you give him an inflated picture of your assets, he is very likely to find this out later and lose confidence in you.

Deal With Only One Bank. Unless your average bank balances and your net assets are far larger than those of the ordinary welding business it will be better policy to do all of your banking with one bank in preference to opening two or more accounts. Your banker is interested in seeing your business grow and the size of your financial transactions increase so that he will have more money to handle. He is far more likely than otherwise to give you the value of his knowledge and experience generously if he knows that as your business expands his will be the only bank to share your prosperity.

Maintaining Satisfactory Balances

Your banker is interested in having you maintain satisfactory average balances in your account, because he, of course, must make his profit from investing certain proportions of your balance along with that of other balances. If your average unused deposits from month to month run into several hundred or even thousands of dollars, the banker can naturally make more profit from your account than if you are down to your last "nickel" most of the time.

Many banks require all checking accounts to be of a certain average size, otherwise a monthly fee is charged. Other banks have a plan of making a charge of a few cents for each check drawn if the average balance runs below a specified figure. It is well to have an understanding on all these points.

(To Be Continued)

Training-Welders Conference Held in Omaha

In order to make an initial study of oxy-acetylene welding for the purpose of outlining possible training units and determining the scope of the instruction needed co-operative arrangements were made between the Department of Vocational Education of the Omaha Public Schools, the Nebraska State Department of Vocational Education, and the Federal Board for Vocational Education. A group of thirty-three people, including twenty-five welders, representing various phases of welding, and eight persons interested in welding from the standpoint of training, was organized by Mr. J. R. Hawke, City Director of Vocational Education in Omaha. The group was in session eight days, four hours each day, from January 11th to January 19th, at the Union Pacific Railroad Headquarters Building. The conference work was conducted by Messrs. C. F. Klinefelter and R. V. Billington of the Federal Board for Vocational Education, Washington, D. C., assisted by Mr. Sidney Owen, State Supervisor of Trades and Industries in Nebraska.

The personnel of the Conference Group was as follows:

Frank Amburst, Swift & Company, Omaha, Nebraska.
R. V. Billington, Federal Board for Vocational Education, Washington, D. C.
Clarence Cady, Cady Blacksmith Company, Omaha, Nebraska.
H. W. Carmichael, State Supervisor of Trades & Industries, Des Moines, Ia.
Arent Christensen, Union Pacific Railroad, Omaha, Nebraska.
B. W. Criswell, The Balbach Company, Omaha, Nebraska.
W. C. Cumming, Aeronautical Consultant, Omaha, Nebraska.
J. M. Dulaney, Linde Air Products Company, Kansas City, Missouri.
P. L. Edger, Omaha Steel Works, Omaha, Nebraska.
P. E. Engler, The Balbach Company, Omaha, Nebraska.
F. I. Hankins, A. N. Eaton Metal Products Company, Omaha, Nebraska.
J. R. Hawke, Omaha Public Schools, Omaha, Nebraska.
Otto H. Jensen, Union Pacific Railroad, Omaha, Nebraska.
V. E. Karr, Council Bluffs Public Schools, Council Bluffs, Iowa.
Arthur King, Allan Ice Machine Company, Omaha, Nebraska.
C. F. Keusenkamp, State Supervisor of Trades & Industries, Pierre, S. D.
John Kingery, Aero Welding & Auto Repair Company, Omaha, Nebraska.
C. F. Klinefelter, Federal Board for Vocational Education, Washington, D. C.
J. R. Lipert, Omaha Welding Company, Omaha, Nebraska.
Robert Masters, Nebraska Power Company, Omaha, Nebraska.
W. A. McGuire, Allan Ice Machine Company, Omaha, Nebraska.
C. W. Mullane, Omaha Public Schools, Omaha, Nebraska.
Sidney Owen, State Supervisor of Trades & Industries, Lincoln, Nebr.
Laurence Parker, State Supervisor of Trades & Industries, Topeka, Kans.
George Patricia, Baker Ice Machine Company, Omaha, Nebraska.
I. C. Reed, Gate City Welding Company, Omaha, Nebraska.
E. R. Ripley, George & Company, Omaha, Nebraska.
Frank H. Schley, Pennsylvania Consumers Oil Company, Council Bluffs, Ia.
L. O. Schneiderwind, Omaha Welding Company, Omaha, Nebraska.
Harry Striker, Metropolitan Utilities District, Omaha, Nebraska.
Joseph Tepoel, Grand Island Public Schools, Grand Island, Nebraska.
George A. Thrapp, The Balbach Company, Omaha, Nebraska.
C. W. Wetzel, State Supervisor of Trades & Industries, Jefferson City, Mo.

The material developed in the group conferences is designed to be of suggestive value and assistance to instructors and foremen who are experienced welders themselves, and who are called upon to teach others or "break them in." For this reason it does not attempt to detail the "how" or the "why," as the experienced instructor will supply this from his own experience and trade knowledge. It does outline the "what" of welding which the group felt should be taught. It represents important "high points" which an experienced welder should not overlook in teaching others.

The conference group outlined a basic training program for welders. This course is designed to bring a "green hand" up to the point where he will be an asset as a welder and not a liability. The various jobs that the welder is required to do were listed according to the metals involved. The following list of major activities will give an idea of some of the welding jobs that were discussed and analyzed.

A. Welding Steel
   1. Tanks
   2. Boilers
   3. Pipe
   4. Structural
   5. Aircraft
   6. Automotive
B. Welding Cast Iron
   1. Stoves, Furnaces and Grates
   2. Ornamental Work
   3. Reclamation Foundry Work
   4. Boilers
   5. Automotive
   6. Industrial Machinery
C. Hard Surfacing Ferrous Metals
D. Welding and Cutting in Railroad Shops
E. Welding Refrigeration Equipment
F. Use of Welding Torch in Heat Treating Metals
G. Welding Aluminum
   1. Cast Aluminum
   2. Sheet Aluminum
H. Welding Monel Metal
I. Welding Copper and Its Alloys
J. Welding Lead
K. "Bronze Welding" and Brazing
L. Miscellaneous Use of Welding Torch and Gases.

It is expected that the material developed in the initial stage in Omaha will be checked, revised and expanded through similar conferences with other groups of welders in other cities, as part of a study of welding which is being carried on by the Federal Board for Vocational Education. When all of the necessary information has been assembled it will be made available in printed form.

(Signed) J. R. Hawke,
Director of Vocational Education
Omaha Public Schools.

Commenting on the above report, Mr. B. W. Criswell, Sales Manager of the Balbach Company, Omaha, Nebraska, says, "These vocational schools are now being held at Omaha, Neb., Beatrice, Neb., Lincoln, Neb., Columbus, Neb., Grand Island, Neb., Sidney Neb. Sioux City, Iowa, and Council Bluffs, Iowa. The courses are being run 60 hours and in some schools they are running five nights per week; while others are two nights per week and some four nights per week. The enrollment is from ten to twenty students per class. The students enrolled cover all classes of layman such as garage men, pipe line men, creamery, milling, utilities and a number of other types of industrials. The second semester starts

(Continued on Page 58)

Chicago Section Discusses Structural Welding

The welding of structural steel for buildings was the subject of the regular meeting of the American Welding Society, Chicago Section, which was held Friday evening, February 5. The subject was introduced by the presentation of motion pictures showing the welding on the office buildings in Boston, Los Angeles and Dallas. These films were supplied through the courtesy of the General Electric Company and were supplemented by comments and discussion by Mr. W. B. Frackelton of the Chicago office of the General Electric Company.

Following the showing of the motion pictures, Ernest Lunn, Consulting Engineer, Chicago, gave a summary of the important features of the report of the Structural Welding Committee and discussed the conclusions which were drawn in this report with reference to the design values of welded joints, the comparative merits of different types of joints investigated by the Committee and the significance of qualification tests in structural steel welding.

The application of welding to home building was covered in an illustrated talk by Henry Dubin of the firm of Dubin & Eisenberg, architects, Chicago. Mr. Dubin recently finished the construction of a home in one of the North Shore suburbs and in his talk he showed a number of the advantages of welded construction in residences. The work which he has already done involves the use of many ingenious ideas, but Mr. Dubin left a very strong impression that he anticipates a great deal of new progress and the development of many new ideas in future work.

Indiana Welders Meet at South Bend in April

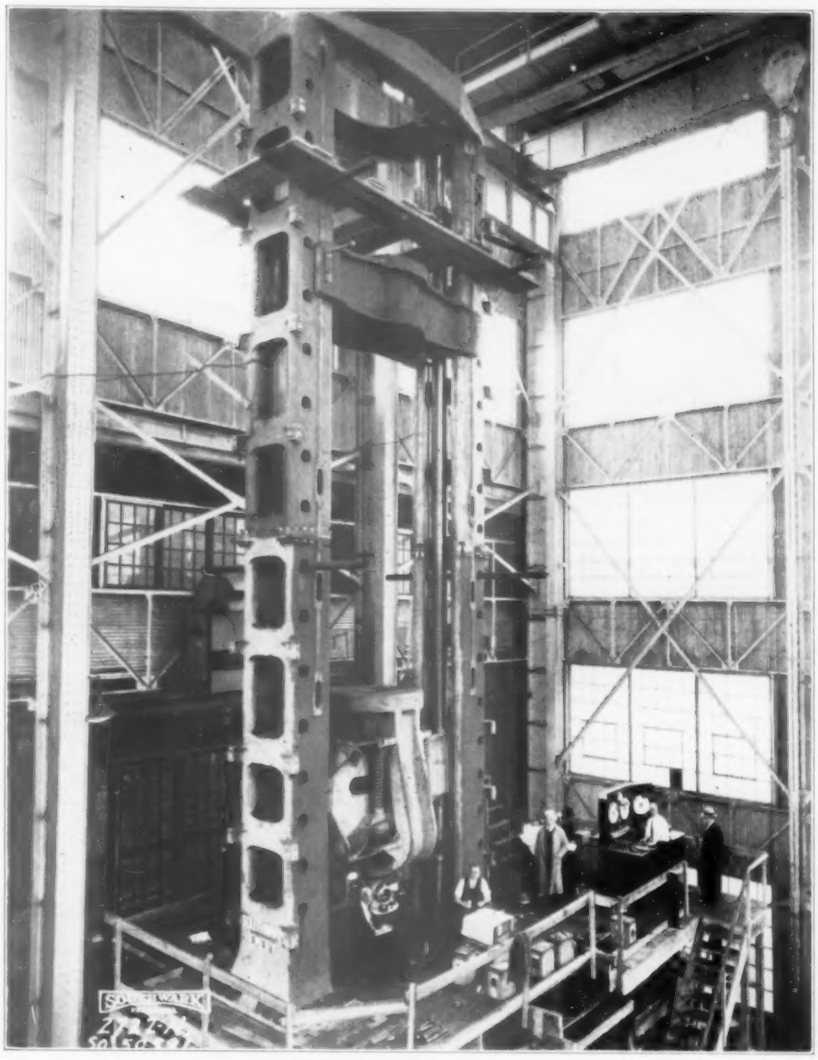
The Indiana Association of Ironsmiths and Welders will hold their 33rd State Convention at South Bend, Ind., April 5 and 6, at the La Salle Hotel as headquarters.

All ironsmiths and both electric and acetylene welders are most cordially invited to attend this convention. Talks will be made by welding authorities on new metals and the application of welding to them, together with moving pictures and demonstrations.

Testing Machine Will Give 2000-Ton Loading

There has been completed and shipped from the shops of Baldwin-Southwark Corp., Eddystone, Pa., to the University of California at Berkely, Cal., the largest testing machine in the world. In point of dimension it is by far the largest.

It is able to test columns up to 33 ft. 6 in. long in compression and up to 4,000,000 lbs. load. In tension it accepts specimens up to 33 ft. 6 in. diminished by machine stroke and will apply loads up to 3,000,000 lb. The spread between the columns is 10 ft. and the table is 12 ft. long. Since the table is level with the laboratory floor a truck may drive between the columns and the specimens be lifted directly from the truck body by the testing machine itself.



This Largest Testing Machine in the World Can Exert a Load of 4,000,000 Pounds in Compression and 3,000,000 Pounds in Tension.

There are many unique features of this Southwark-Emery testing machine in addition to its great size and unprecedented capacity. Since the principal load application is hydraulic it is necessary to provide a cylinder and ram and a pressure producing fluid pump. The ram on this testing machine is 46 in. in diameter and the hydraulic pressure is about 2,500 lb. per sq. in. when operating at capacity.

The table of the testing machine is stationary being secured directly to the foundations. The ram is fastened to this table. The cylinder, therefore, is the movable element and to it is fastened by lug extensions two vanadium steel screws 12 in. dia. 56 ft 8 in. long threaded double ⅓ square threads per inch. By means of long bronze nuts which are bedded in the lower cross-head (which carries also the weighing system and, in a yoke, the lower grips for tension testing) the loads are transmitted from the screws to the cross-head.

Compression tests are carried out between the lower cross-head and the table while tension tests are made between the upper cross-head and the yoke around lower cross-head.

The cast steel table to which the main cylinder ram is fixed and on which the cast steel columns rest is 17 ft 3 in. by 6 ft. 6 in. in plan and weighs nearly 50,000 lbs. Its depth is 35 in.

This machine stands 46 ft. 9 in. above the floor line and the foundations to about 25 ft. below. The depth of the pit is 19 ft.—a concrete tank of nearly 1,000 bbl. capacity. Total weight on the foundation about 475,000 lbs.

G. P. A. Will Continue Investigations

At the meeting of the Gas Products Association which was held at the Lake Shore Athletic Club, January 22, and 23, the report of the Special Technical Committee, which has been investigating the possibilities of improved oxy-acetylene welding procedure was enthusiastically received and it was voted to continue these investigations on a more extensive scale just as rapidly as possible. The

Association has made arrangements to provide all members with a centralized publicity service to aid in the preparation of catalogs, bulletins, special reports and other direct advertising literature. Following a series of discussions of merchandising possibilities under 1932 conditions, members were treated to a visit to the Century of Progress buildings and held a final session and election of directors in the Administration Building of the Century of Progress. The convention closed with an enjoyable dinner at the Lake Shore Athletic Club. The officers and directors elected for the ensuing year were as follows: E. L. Mills, The Bastian-Blessing Company, Chicago, President; A. J. Fausek, Modern Engineering Company, St. Louis, Mo., Vice-President; W. H. Ballance, Electrox Company, Peoria, Illinois, Second Vice-President; Lloyd Keenan, Secretary; Mary Redden, Asst. Secretary; A. C. Krein, The Bastian-Blessing Company, Chicago, Treasurer and Earl Evleth, The Bastian-Blessing Company, Chicago, Counsellor. The following members were appointed on the Executive Committee: E. L. Mills, The Bastian-Blessing Company, Chicago; H. B. Pearson, Compressed Industrial Gases, Inc., Chicago, and M. L. Goodrich, Swift & Company, Chicago. The following directors were appointed: W. H. Ballance, Electrox Company, Peoria, Ill.; O. E. Engler, The Balbach Company, Omaha, Nebr.; A. J. Fausek, Modern Engineering Company, St. Louis, Mo.; M. L. Goodrich, Swift & Company, Chicago, Ill.; L. F. Loutrel, Shawinigan Products Corp., New York City, G. W. McCauley, Grand Rapids Welding Supply Company, Grand Rapids, Mich.; E. L. Mills, The Bastian-Blessing Company, Chicago; H. B. Pearson, Compressed Industrial Gases, Inc., Chicago, Ill., and E. H. Smith, Commercial Gas Company, Minneapolis, Minn.

A. W. S. Participates in New York Safety Conference

The American Welding Society is one of the national organizations participating in the Third Annual Greater New York Safety Conference which is being held at the Pennsylvania hotel, New York City, February 24 and 25, under the auspices of the Metropolitan Chapter of the American Society of Safety Importance. While there is no special subject on the program which deals directly with safety in welding problems, there are a lot of subjects which are of indirect interest to the welding fraternity.

Representing the American Welding Society on the general committee of the safety conference is Mr. H. S. Smith of the Prest-O-Lite Co., New York, who has for a number of years taken a great interest in the safety aspects of the welding industry. The industry now has a good safety record and should strive in every way to keep it. Attendance at the forthcoming conference will give many plant executives, who have welding departments under their control, an opportunity to learn of more ways and means to keep welding operations free from a variety of indirect accident possibilities in their plants. Special sessions will be devoted to such important general subjects as, first aid, curing accident habits, utility of facts relating to accidents and the importance of safety work outside of the plant.

"The Spirit of Welding"

An interesting drawing has been produced by the Federal Machine & Welder Co., Warren, Ohio, to present a symbolical picture of the electric welding processes. The central figure symbolizes speed and strength, with speed further emphasized by the winged helmet and heels.

"The Spirit of Welding."

The figure holds aloft representative machines used for these processes, and in the other hand carries scientifically processed wires for metallic arc welding. The world itself is used in the picture to show the breadth of application of the welding art. This design is being used in advertising, in circulars and on the company letterheads.

Koro Directors Elect Officers

At a meeting of the Board of Directors of the Koro Corp., 3021 Madison St., Bellwood, Ill., on February 1, 1932, O. L. Howland was elected President and General Manager; Roger Cahoon was elected Vice-President, Secretary-Treasurer.

Harnischfeger Corp. Has Acquired Hansen Arc Welder

Manufacturing rights for the well known Hansen arc welder have been acquired by the Harnischfeger Corp., of Milwaukee, Wis. The Hansen welder, which has won a considerable reputation by virtue of its simplicity and the ease with which its arc can be maintained, was developed by the Northwestern Mfg. Co., Milwaukee, and has been manufactured and marketed by that concern for some years. The Harnischfeger Corp. announce that in taking over this new line, they will continue to produce the Hansen arc welder in the same range of sizes, and with the same structural features as previously—notably, the single current control, the self-exciter feature, and the internal stabilizer.

Mr. Klaus L. Hansen, inventor of the Hansen welder, and for some years a technician in the developing of welding equipment, has joined the staff of the Harnischfeger Corp. The Harnischfeger Corp. has had a very extensive experience in the manufacture of electric motors, controllers and other parts. For approximately forty-five years, Harnischfeger (widely known under its trade symbol as "P & H") has been engaged in the production of a very complete line of electric hoists and overhead cranes, for which all of the major electric equipment was designed and manufactured in the P & H plant.

Modern Engineering of El Paso in Merger

The Modern Engineering Co. of El Paso has formed a merger with the Francis Wagner Co., which has been one of the best known construction and mining equipment firms in the southwest, formerly located at 307 San Francisco street, El Paso, Texas. The combined facilities and stock of the two firms have been moved to 1600 Texas street and general offices and warehouse established at this address. The merged concern will operate under the title of the Modern Engineering Company of El Paso. Mr. Francis Wagner is president and general manager of the new firm and W. J. Chesak is secretary and treasurer. Both firms are old and well established distributing organizations and the merger brings under one roof an enlarged service to meet the demands of the trade area.

South-Wide Welding Conference to be Held in May

Announcement has been received of the first south wide welding conference, which will be held at Alabama Polytechnic Institute, Auburn, Alabama, from May 23rd to May 28th. This conference has been planned to spread over several days so that there will be plenty of time allowed for both lectures and demonstrations. According to present plans, there will be about twenty papers read, discussing all phases of the applications of fusion welding for both production work and maintenance work, and about thirty exhibits of up-to-date welding equipment and welding materials.

More Expansion by Puritan Compressed Gas Corp.

Announcement of a second expansion by the Puritan Compressed Gas Corporation, Kansas City, Mo., just has been made by Parker B. Francis, secretary and treasurer, a fine record for a year in which many other concerns have curtailed operations.

The first expansion by the company was a new plant in North Kansas City. The second, just being completed in-

creases office and display space to twice that formerly occupied in the building at 2012 Grand avenue.

At this address the Puritan Corporation will occupy 7,500 square feet of showroom and office space, where will be displayed all of the many kinds of gas apparatus used in industries and in hospitals by the medical profession.

Included in these expanded facilities of advantage to customers is a large parking space in the rear of the building, together with a complete service and supply department where their entire wants may be taken care of at a most convenient downtown ground floor location.

The size of the executive offices will be increased and there will be a large and comfortably equipped lounging room for employees. In addition, to facilitate the showing of moving pictures illustrating the use of Puritan products, which is done frequently before professional groups, will be a lecture room seating 100 people.

Mr. Francis states that in addition to expansions made in 1931 the company has increased the number of its employees and has maintained all salaries.

American Office Established By R. Fuess

Announcement has been received that American headquarters have been established for the firm of R. Fuess of Berlin, manufacturers of scientific instruments. The parent concern has for over a century been manufacturing precision instruments and research equipment for both laboratory and industrial use including equipment for microscopy, crystallography, flow and pressure recording and temperature recording. The address of the American office is, R. Fuess, 245 West 55th street, New York.

Clark Controller Co. Takes Over Una Line

On January first the management of the Una Welding and Bonding Co. was taken over by the Clark Controller Co., who will have entire charge of both production and sales. The name of the company has been changed to Una Welding, Inc., and the sales of Una products will be handled by the district offices of the Clark Controller Co. as well as by the former distributors of Una Welding and Bonding Company.

G-E Welding Design Course Proves Successful

At the end of 1931, three months after the start, a total of 61 students had completed the new General Electric course in the design of welded steel structures. Of this total, 27 were representatives and engineers of General Electric customers and the remainder were General Electric apprentices.

The average time consumed in completing the course was four weeks. One student, however, who was particularly interested stayed ten weeks for a supplementary course. The representatives and engineers from customers' organizations came from all over the United States and also from Canada and Russia.

Welding Safety Bulletin for Petroleum Industry

In an effort to reduce the number of accidents in the petroleum industry caused by lack of adequate precautions and information concerning gas and electric welding, cutting, and burning, as well as the use of open fires in mechanical operations, the American Petroleum Institute has published an "Accident Prevention Manual on Gas and Electric Cutting and Welding." It represents the work of the Institute's Division of Refining Committee on Accident Prevention in Refineries and cooperating representatives of companies throughout the industry.

The manual covers health and accident hazards, discusses the problem of training new workmen and overcoming carelessness in others, and takes up in turn gas welding, electric welding and their application to the various tasks of the petroleum industry.

The publication is one of a series of manuals on accident prevention. A manual on "Cleaning Petroleum Storage Tanks" came from the press in August, 1931, and the manual on "Safe Driving of Automobiles" was published in December, 1931. About 20 others are in course of preparation.

Copies are available at Institute headquarters, 250 Park Ave., New York, or the Institute's Department of Accident Prevention, 1508 Kirby Bldg., Dallas, Tex. Discounts are granted on quantity orders.

The Effect of Temperature on the Properties of Metals*

The 27 papers in the book are largely compilations of data from many sources, domestic and foreign. The book has been divided into two general sections, one dealing with Engineering Trends and Requirements for Metals at High and Low Temperatures, the other with the Properties of Available Metals for High- and Low-Temperature Service.

Within the engineering fields covered, the 38 authors who prepared the papers have had the task of summarizing the information contained in the extensive literature, of appraising it critically and of adding unpublished information. Not only are the papers of interest both as to the data presented and their appraisal, but the discussions which comprise more than 200 pages of the finished book have added much in further unpublished information and valuable comment.

This unusual amount of discussion resulted from a departure from the usual method of conducting technical sessions. The papers were not presented by the authors, but those in each group were summarized respectively by two prominent and able investigators in this field. The papers were preprinted and distributed well in advance of the meeting so that the men interested could digest them and prepare their discussions. As a result of this procedure, more than two-thirds of the time in each session was devoted to discussion. It has added greatly to the value of this book.

Steps have been taken to make the book a ready reference volume, both in respect to specific and general topics relating to temperature effect on metals. A specially prepared introduction has been written which gives a brief history of the events leading up to the Symposium and summarizes the more important points of the papers. For those who may wish to delve into the great mass of data in the book, there is an extensive Subject Index and an Author Index. A bibliography of 600 annotated references is also included. It covers the period April 1, 1930-1931, and supplements the bibliography published with the 1924 Symposium and the two separate ones published by the A. S. M. E. in 1928 and 1931.

The book published jointly by the A. S. M. E., 29 W. 39th St., New York City, and A. S. T. M., 1315 Spruce St., Philadelphia, may be ordered through the headquarters of either Society. It is bound in blue cloth, 6 by 9. Price, per copy, $6.00.

*Symposium sponsored by the A. S. M. E. and A. S. T. M. and the Joint Research Committee, presented in Chicago, June, 1931.

New Airco Pocket Size Catalog

The Air Reduction Sales Co. of 60 East 42nd St., New York City, has issued a new catalog descriptive of Airco-Davis-Bournonville Welding and Cutting Apparatus and Supplies. The catalog is pocket size, of 26 pages, indexed for ready reference; and lists specifications and prices on all types of welding and cutting torches, regulators, cylinder trucks and hose connections. The illustration is elaborate, including photographs of the most recent developments in torches and oxy-acetylene outfits manufactured by the Air Reduction Sales Co. There are also detailed illustrations of several of their mechanically operated machines, the Radiagraph, Camograph and No. 1 B and No. 4 Oxygraph.

Murex Electrode Bulletin Now Ready

A twelve-page bulletin describing the Murex line of arc welding electrodes, which have a heavy all-mineral flux coating, has been published by the Metal & Thermit Corp., who are acting as exclusive sales agents for the American Murex Corp. Both companies have offices at 120 Broadway, New York, N. Y. The Murex electrodes are made 18 inches long and in types and sizes suitable for a wide range of horizontal, vertical, and overhead welding operations. A feature of the electrode is a patented spiral winding of asbestos yarn which serves to hold the heavy mineral flux to the core so that it is not injured if the electrode is bent. The manufacturers point out that the all-mineral ingredients of the flux on a Murex electrode causes it to burn without objectionable fumes or smoke, while the

thickness of the coating enables the operator to ride the electrode on the work, thus letting the flux coating space the arc. Among the eight types of electrodes in the line there are electrodes for welding commercial mild steel, manganese steel, 18-8 stainless, and stainless iron.

"Aluminum and Its Alloys" Describes Properties

The Aluminum Company of America, Pittsburgh, Pa., has recently published a 64-page pocket size book entitled, Alcoa Aluminum and Its Alloys. The book gives in concise form information concerning the physical and chemical properties of aluminum alloys produced by the above company. In addition to this, it contains tables showing the sizes of the basic commodities which the company manufactures from these alloys. The commercial tolerance for the various commodities are also given. Several pages of illustrations show some unusualy interesting uses of these alloys and their particular advantage in reducing the weight of railroad cars and other types of transportation equipment.

New Lincoln Bulletins Cover Structural Studies

Several new bulletins on weld design have recently been issued by the Lincoln Electric Company of Cleveland, Ohio. Three of them, plates 30, 31 and 32 in the series of studies in structural arc welding are devoted to arc welding in mill buildings. Plate 30 shows methods of making purlin connections to an existing structure. Plates 31 and 32 deal with rod braces in mill buildings. Rods are particularly desirable for bracing purposes and a number of simple welded connections are shown in these two plates. A fourth bulletin, Application Sheet No. 27, discusses and illustrates the elements of design for bosses and bearings. In the designs suggested full recognition is given to the requirements of the job and the methods of meeting these various requirements are shown by suitable diagrams.

New Bulletin on Taylor Fittings and Flanges

Bulletin No. 32-1 just issued by the Taylor Forge & Pipe Works, Chicago, is a complete up-to-date tabulation of dimensions and lists prices of the Taylor line of welding fittings and welding flanges for pipe work. The diagrams of pipe fittings for turns, tees, closed-ends and reducers as well as several types of flanges are shown.

A-C Arc Welding of Aluminum

Commenting on the information published in the January issue of THE WELDING ENGINEER regarding the use of flux developed by him for arc welding of aluminum, Dr. Fred Post, Peekskill, N. Y., states that satisfactory results can be obtained by using the alternating current with the following procedure: Make a thin paste of the flux by adding a little water and use this to paint both the seam and the welding wire. Do not wait for the flux to dry because it will dry during welding. Lay a copper plate under the work to be welded. Use a carbon electrode and feed in the wire, or rod, with the left hand. The welding wire, or rod, used should be as nearly as possible the same as the material being welded.

Bulletin on Automatic Eye Shields

A new four-page bulletin describing the Magno Matic eye shield has recently been issued by the Michigan Welding Supply Corp., Muskegon, Mich. This is a device which can be supplied either as a head shield or a hand shield. It is fitted with a mechanism which removes the protective lense from the line of vision when the arc is not operating, and automatically brings the protective glass in front of the eyes the instant the arc is struck, so that the welder has full view of his work at all times, with the protective glass in front of his eyes only at the time when it is needed. The bulletin describes the different types of shields, shows the method of making connections and gives illustrations of the advantages of this type of eye protection in various classes of welding work.

Una Welding Rod Booklet Now Ready

Bulletin No. 140 just issued by Una Welding, Inc., Cleveland, Ohio, gives a complete list of the Una coated welding rods for manual and automatic arc welding. The line includes rods for production work in mild steel, for building up wearing surfaces, for stainless steel and copper and copper alloy welding. In tabular form, the information is given regarding the nature of the deposit made by each rod, the hardness and the recommendations for the position in which work should be done. The bulletin also illustrates and describes arc welding machines, automatic units and arc welding accessories.

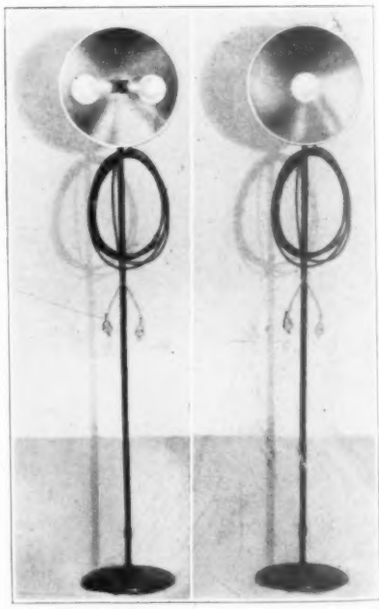
Page Announces New Hi-Tensile Electrodes

The Page Steel and Wire Co., has developed a new type of coated electrode which is said to give extremely quiet operation with little or no sputter. Inasmuch as the arc is free burning, the molten pool of metal can be readily observed and the amount of metal deposited accurately judged. It is stated that the grain structure of the weld is essentially the same as that of mild steel and boiler plate base metal and in fact practically the only difference between the two structures is that the deposit from Page Hi-Tensile Electrodes shows a finer grain. The electrode results in deep penetration and extremely sound welds. The strength of the finished weld is equal to that of the base metal with a total elongation of over 30 per cent when pulled to destruction. The finished weld is ductile and also responds readily to heat treatment, if heat treatment is desired.

The Page Hi-Tensile Electrodes do not require reverse polarity for efficient operation. If reverse polarity is used, faster speeds may be obtained, however. Other advantages claimed for this electrode are that it can be bent to a reasonable degree without the coating peeling or falling off. The coating is moisture proof and it requires no baking before using.

Spot Light for Arc Welders Speeds Work

A portable spot light for lighting up arc welding operations in places not reached by ordinary shop light and drop lights has just been put on the market by the McClean Welderlite Company (not Inc.), 7133 S. Lincoln St., Chicago, Ill. The light has a 12" bowl with aluminum finish inside. The bowl is fully adjustable for throwing light in any direction and is equipped with a handle to make it easy to move around. The standard equipment includes a length of iron pipe which gives a floor light about 5' high. One section of this can be taken out, so as to reduce the height to 18" or, if desired, it can be removed from the



McLean Welderlites, One and Two Bulb, With Extension Rods.

stand altogether and used as a drop light. By using two way, or three way, sockets more than one bulb can be used in one reflector.

This light is made to operate from the welding circuit of the generator instead of from the shop circuit. It can be connected to the ground and electrode or to the terminals of the machine as desired. The use of this lamp makes it possible to get good lighting on work

in practically any location independent of the shop lighting circuit, as it is not necessary to look around for wall outlets and extension cords. There is practically no current cost, while it is in operation, because it works from the welding generator. When the arc is struck, the light is automatically reduced so that it is practically extinguished and shop tests have already indicated that its operation has no appreciable effect upon the welding current. It is recommended particularly for work in out-of-the-way places, such as in boilers and around large tanks and large pieces of equipment which are not well lighted by the shop lighting arrangements. Complete equipment includes a stand, an extension for converting into floor lamp and 10 feet of cable with clips and a 100 watt bulb.

New Flux Announced for Tinning Operations

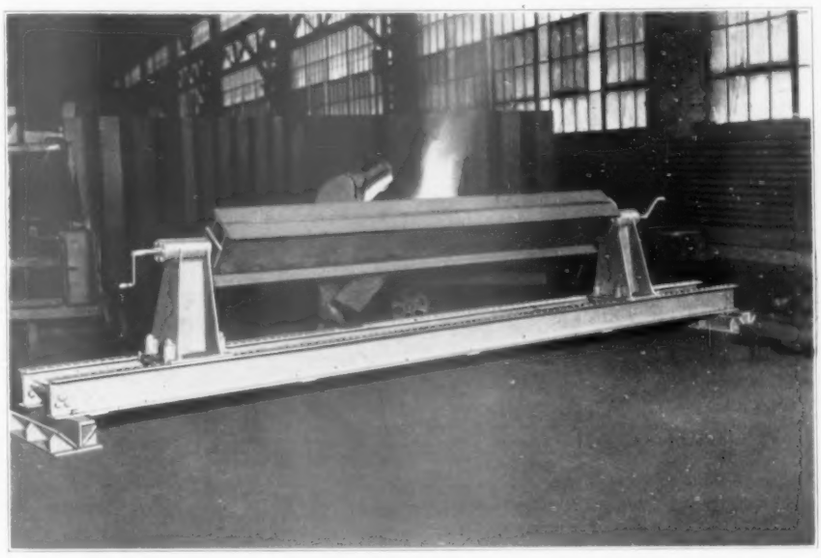
A new fluxing compound, "Tinol," has recently been developed by the American Solder and Flux Company, Philadelphia, Pa. This material is used as a dry powder and manufacturers claim that it will deposit a perfect coating of tin on all metal surfaces even though the surface may be dirty, rusty or greasy. It is claimed that this compound makes a particularly satisfactory tinning preparation for automobile fender and body repair work. It is put up in 16 oz. tins.

Bundy Tube Uses Copper and Steel

The Bundy Tubing Company, Detroit, Michigan, are installing a General Electric tunnel type furnace for the commercial welding of tubing by the copper hydrogen electric welding process. The tubing produced is double walled with the walls copper welded throughout the entire circumference. In forming strips steel and copper is fed into rolling machines where it is carried over stationary arbors that first clamp the sides of the strip and by successive stages finally roll it into a double walled tube. The hydrogen charged electric furnace by means of controlled diffusion of the two metals, copper and steel, under high electric heat produces a homogeneous solid wall structure with a coating of copper. Thus, for all practical purposes there is produced a single walled tube with the added strength of double wall construction. This type of tubing has been very popular in the motor car industry and is now being recommended for the electric refrigeration industry, gasoline and oil lines, hydraulic brake lines, conduit tubes and windshield wiper tubes are some of the applications for motor car use. The tube is offered in diameters of from ⅛ in. to ⅝ in. O. D. It takes all standard types of fittings and can be supplied in lengths or coils. Coincident with the installation of the new furnace for the manufacture of this product, the Bundy Tubing Company has been advertising its facilities for commercial welding of these products.

New Welding Fixtures Reduce Handling Costs

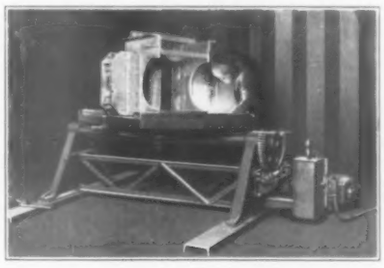
The Harnishfeger Corp., Milwaukee, Wis., has recently entered the welding field with the introduction of a line of welding fixtures known as position finders. These devices were developed first for use in their own plant where a large number of welded parts are welded for cranes and for crawler type excavators.



Harnischfeger, Type L, Position Finder for Use on Long Narrow Parts. It Is Manually Operated.

The position finders are simple devices for holding heavy parts at such angles as to permit the 45° welding which is necessary for smooth, strong welds. The type L position finder is manually operated and is designed for long, narrow parts on which welding is to be done on all sides. This will handle structures up to 16 ft. in length. Revolution of the structure through the full 360° is possible. The type T position finder is of the table type and is electrically operated. The piece to be welded is clamped to the table and the bed of the table is then tilted by means of an electric motor drive to the required angle. This model is manufactured in two sizes, one for handling pieces up to 4,000 lbs. in weight and the other having 8,000 lbs. capacity.

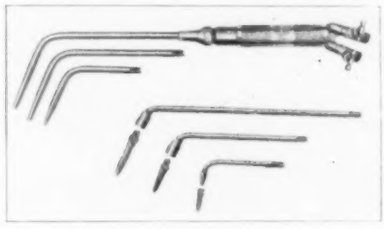
The position finders not only make it possible to obtain a correct welding angle on heavy, cumbersome pieces but also save very materially in handling time, thus reducing the costs in the welding department. Actual working tests, reported in a previous issue, have demonstrated that the use of these position finders result in a 56 per cent increase in the amount of welding handled with no increase in labor cost and with a 15 per cent decrease in the amount of welding material used. To these savings can be added the increase in production time of the welding operators, themselves, who do not have such long periods of idleness, while they are waiting for work to be brought into an easy welding position, or have their work slowed up for them by being forced to work under unfavorable conditions.



The Type T, Motor Driven Unit Is Made in Two Sizes, 4,000 and 8,000 Pounds Capacity.

Milburn Type HMS Welding Torch

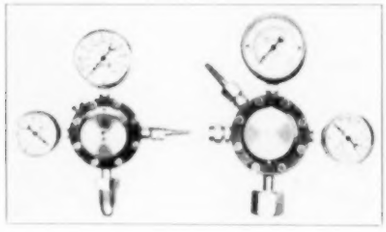
The Alexander Milburn Co., Baltimore, Md., announce a new welding torch, known as the Type HMS which is their latest development in welding apparatus. The HMS torch is recommended for all types of welding. Copper, swaged welding tips are usually furnished but they may be removed from the torch handle and replaced by extensions of various lengths. These extensions are light, but unbreakable nickel-silver tubes utilizing Milburn standard Type FX and UB Welding Tips. By means of the Type HMS Torch handle, swaged tips and extensions the user has at his disposal a versatile welding assortment capable of handling a wide range of welding work.



Milburn Type HMS Torch.

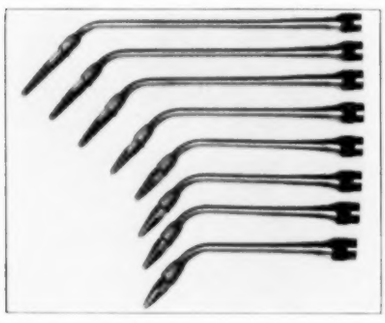
Linde Announces New Purox Regulators

The Linde Air Products Co., 30 East 42nd St., New York, N. Y., has recently introduced an entire series of new and improved Purox oxygen and acetylene regulators superseding its former line of Purox Metal Master type of regulators. All Purox welding or cutting outfits now include these new regulators



New Purox Regulators.

where formerly Metal Master regulators were supplied as part of the regular equipment. All regulators in this series have the same general external appearance. They are of all-metal construction, simple, compact, rugged and workmanlike in appearance and reliable in performance. One of the outstanding design features is an accurate self-aligning valve of the nozzle and yoke type, which is said to insure sensitive action and freedom from leakage. The construction also eliminates any need of disturbing the diaphragm, bonnet, pressure adjusting screw, or pressure adjusting spring when replacing a worn valve seat. Access to the interior of the regulator is gained by merely removing a plug in the rear of the body. The seats are made of a material not easily marred, scratched or damaged by foreign particles that might find their way into the inside of the regulator.



New Series Oxweld Heads with Detachable Tips.

They have also announced a new series of welding heads with detachable tips for use with the Oxweld Type W-17 welding blowpipe. These will supplement the one-piece style heads for this blowpipe, so that the user will have a choice of two types of welding heads.

The new detachable tip heads were developed particularly for pipe line welding and for production operations. The new tip produces the same type of flame as that produced by the one-piece welding head for the Type W-17 Blowpipe. Sizes Nos. 6 to 13, inclusive, are available in the new welding heads.

Rust Proofing Materials Withstand High Temperatures

The Skybryt Co., of Cleveland, Ohio, recently announced Rust-Tox, a preparation for removing and preventing rust. In welding operations, it can be used for cleaning materials or for coating the welding area to prevent corrosion. The manufacturers claim that it will stand extreme contraction and expansion, and resist temperature up to 550° F. It is transparent or can be pigmented with color—red or black, or aluminum flakes. Metals may be brushed or sprayed at any temperature above 35° F. It normally covers about 1500 sq. ft. per gallon. It is recommended for sealing rust surfaces, preventing further rusting and preparing a surface for a long life paint job.

News of the Industry

C. B. Irish, vice-president of the Leader Iron Works, Decatur, Ill., recently announced several changes in the duties of members of that company. Mr. Irish, who has been connected with the organization for more than 20 years, is supervising director of the company's refining and marketing branches of the oil industry. W. R. Statham is in charge of engineering and design of refinery and natural gasoline plant equipment. C. S. Whitman and C. F. Koenig are devoting their full time to field engineering. Both of the two latter named have been with the Leader organization for years and have a background of practical and technical experience in the metal industry.

Charles F. Abbott, executive director of the American Institute of Steel Construction, was the principal speaker at a recent meeting and luncheon held at the Alexandria Hotel in Los Angeles, Cal., which was arranged by the manufacturing and industrial committee of the local Chamber of Commerce. A large number of engineers, architects and builders were in attendance as well as a number of executives from various branches of the metal trade industries, members of the American Welding Society, etc.

The Mid-Continent section of the A. S. M. E. held an all-day session in the ballroom of the University Club in Tulsa, Okla., on January 15th. Among a number of papers presented during the session was one on the subject of "Progress in Construction of Unfired Pressure Vessels," which was prepared by G. Raymond, manager of Black, Sivalls & Bryson, Inc., manufacturers of welded pressure vessels and other welded refinery and gasoline plant equipment.

The Conveyor Company, of Los Angeles, Cal., recently completed the construction of two interesting all-welded jobs in the form of machines used for cleaning and polishing lemons in packing plants in the citrus fruit belt of California. These machines are of all-welded construction, the principal process employed being the electric arc. Much of the work on these machines is very exacting, and by the application of high-class welding, a material saving in their construction has been effected.

A new welding service shop recently opened for business at 9909 S. Alameda Blvd., in South Los Angeles, Cal. The shop is known as the United Welding Works and will feature general acetylene and electric welding of all kinds, specializing on heavy truck and trailer work, remodeling, etc. Mr. V. F. Thompson, who formerly was associated with the Allen-Oliver Oil Tool Co., is in charge of the new shop.

The Consolidated Steel Corp., of Los Angeles, Cal., has recently turned out a number of heavy all steel, 100 per cent electrically welded truck bodies for use in transporting gravel and other material for the construction of the famous Hoover Dam project at Boulder City, Nev. The construction of these bodies is very heavy, as they are to be subjected to extra hard use.

V. V. Jacomini, of C. F. Braun & Co., manufacturers of welded pressure vessels, natural gasoline and oil refinery equipment, recently returned to Los Angeles after an extended trip, during which he visited the company's headquarters in Houston, Texas, Chicago, New York and intermediate points.

Chester H. Lang, formerly assistant manager of the publicity department, and then comptroller of the budget of the General Electric Company, has been appointed manager of the publicity department to succeed Martin P. Rice, who retired December 31, after more than 37 years of service with the company.

The Advance Body & Welding Works, of Los Angeles, Calif., are furnishing a fleet of ten all-welded gasoline truck tank units for the Emblem Oil Co. which company has announced themselves as distributors of a new brand of gasoline recently placed on the market on the Pacific Coast.

The National Electric Welding Corp., of Huntington Park, Cal., recently completed a welding contract for the Union Pacific Railway which consisted of extensive reinforcing on the railroad company's steel bridge across the harbor ship channel at Long Beach.

H. J. French, since 1929 a member of the International Nickel Company's research staff in Bayonne, N. J., has been transferred to the development and research department in New York to take charge of development work in steel and iron.

The Wilmington Welding & Boiler Works, in Wilmington, Cal., are building an extra 45 feet to the rear of their present plant which is to be used for a department featuring sheet metal work.

Halpin-Kobry, Inc., 4116 Clayton Ave., St. Louis, have been appointed exclusive distributors in the St. Louis territory for Hobart "Constant Arc" welders.

Not only TOBIN BRONZE

but also . . 6 *other* Copper Alloy Rods for gas and electric welding

IMPORTANT savings to industry ...both in production and in repairing plant equipment... have resulted from the development of Bronze Welding. Copper alloy welding rods, because of their strength and low melting points, are extensively used for welding iron, steel, copper and copper alloys by both the oxy-acetylene and carbon or metal arc methods.

There are seven different Anaconda Welding Rods, each with individual characteristics... each particularly adapted to certain types of work. Tobin Bronze — the most widely used because of its acceptance as the ideal rod for the general oxy-acetylene welding of cast-iron and malleable iron—melts at 1625°F.; preheating is usually unnecessary.

The uniform composition and high quality of Anaconda Welding Rods are due to the experience and technical knowledge of The American Brass Company. Tobin Bronze and six other rods described in the column at the right are available through leading distributors of welding supplies . . . usually shipped in bulk, but also obtainable in clearly labeled ten-pound packages. For complete information ask for Publication B-13.

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THE AMERICAN BRASS COMPANY
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OFFICES AND AGENCIES IN ALL PRINCIPAL CITIES

Everdur (for gas or electric welding) is a patented alloy of copper, silicon and manganese and has excellent welding characteristics. Makes high-strength welds on copper, brass, bronze and copper-nickel alloys. Also used on thin sheet metal. Melts at 1866°F.

* * *

Anaconda Manganese Bronze (for gas welding) produces a tough, strong bond, unusually resistant to wear. Especially adapted for building up surfaces subject to abrasion. Melts at 1598°F.

* * *

Anaconda Phosphor Bronze (for gas and electric welding) is extensively used for electrically welding copper, brass, bronze, wrought, malleable and cast iron, low and high carbon steels. Melts at 1922°F.

* * *

Anaconda Brazing Metal (for gas welding) is a high-zinc brass for welding where strength is not essential. Melts at 1634°F.

* * *

Anaconda Electrolytic Copper (for gas welding) is recommended for welding copper where high electrical conductivity is essential. Welds are quite ductile. Melts at 1981°F.

* * *

Anaconda Silicon Copper (for gas or electric welding) is used to fabricate metal furniture and for other sheet metal work. Requires no flux. Has a good electrical conductivity and makes a strong, sound weld. Melts at 1981°F.

ANACONDA WELDING RODS

Here's

THE GOGGLE

for LIGHT welding jobs

THERE'S no fuss or feathers about this goggle—but for downright usefulness and genuine protection on light welding jobs it's hard to beat.

When you buy this goggle you tell us the welding jobs done by the man who's going to wear it. We put in the shade of Noviweld or Calobar lenses that will give him the greatest protection and clearest vision for his particular work.

The 1104 is made of non-heat-conducting Fibre and is fitted with fully insulated, heavy bows and large sized lenses. It's a trim looking goggle and does a beautiful job protecting your men's eyes.

• 1104 FIBRE • WELDING GOGGLE

J376

AMERICAN OPTICAL COMPANY

SAFETY DIVISION — *Branches in All Principal Cities.*

Fatigue Strength and Strain Relief

(Continued from page 41)

Annealing of the peened specimens apparently does not remove all of the effect of peening because the smoother contour of the weld surface, as mentioned before, has an effect in addition to the cold working.

Care must be taken in interpreting the results obtained from the tests on annealing. The specimens tested did not contain large residual stresses, consequently annealing would not be expected to have a great effect. This case is essentially different than that obtained in a composite structure and must be considered as such.

It should also be mentioned that the values given on weld metal should be carefully interpreted, since tests on size effect, show lower endurance limits for the larger size weld specimens. Work on this problem is now in progress and will be published when completed.

(To Be Continued)

Training-Welders Conference

(Continued from Page 50)

on the 15th of February in a number of schools for the advanced course in welding and it is the plan of the Vocational Department to carry on until a student may receive all of the instructions necessary to fit him for a first class welder. I might add that the course thus far has been a success and has created an unusual amount of interest and has been commented on by various industrial managements as being a step to progress in educating men to do better welding. We ourselves feel very proud of an opportunity to cooperate on such a program."

Classified Ads

Help Wanted—75c per line, minimum 4 lines.
Jobs Wanted—4 lines free.
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Count 8 words to line. Add 6 words for keyed address.

FOR SALE

CRAFTSMASTER: The poor man's torch, $15 with three tips. Jobbers wanted.
Torch Shop & Factory, 1637 E. Vernon Avenue, Los Angeles, California.

POSITIONS OPEN

The Makers of Whelite Products for toughening and hardening steel, hard surfacing rods, mineral fluxes for welding cast iron, copper, aluminum, etc., desire men of ability for exclusive distributors in several large cities. Must be able to finance selves. Liberal contract for the right man. Whelite Distributors, 1737 E. 7th St., Los Angeles, Cal.

Wanted—First class, thorough welder with long experience in railroad work. Must be a good engineer and thoroughly familiar with the Spanish language. Must state experience and be able to provide first class references. Willing to sign two year contract. Address, TOPCO, Box 765, Tampico, Mex.

Structural Engineer and sales executive, experienced in designing structural steel and ornamental iron for both riveted and welded construction; experienced in estimating costs, burden application and sales. Available April .. Address Box 442, The Welding Engineer.

POSITIONS WANTED

Mechanical Engineer—Executive experience in design and detail of welded construction. Desire connection with firm now using welded fabrication or one contemplating its use for manufacture of their products. Address Box 447, The Welding Engineer.

Combination Welder—18 years' experience including boiler shop work. Conscientious workman. Good references. Frank Salamone, 2048 N. LaCrosse Ave., Chicago, Ill.

Boiler Maker, Structural Engineer—13 years' experience in these fields and pressure vessel welding. Have supervised high standards of workmanship; demonstrated and instructed in use of covered electrodes. Have foreign experience. Will accept any reasonable offer, willing to travel, leave immediately. S. Stark, 1240 Linda St., Rocky River, Ohio.

Combination Welder—7 years' experience in construction, production and general repair. Expert on Monel and nickel. Will go anywhere. Age 28. American. Good reliable workman. Good references. Luther Tooley, 403 Richmond St., Guyandotte, W. Va.

Welding Engineer—College graduate, 18 years' experience in steel fabrication, last 6 devoted exclusively to application of electric welding, competent to handle any branch of the program of applying electric welding to design, fabrication and erection of structural steel and ornamental iron. Paul B. Covey, 564 N. River Road, Manchester, N. H.

Combination Welder—14 years' active job shop experience. Held executive positions in largest welding repair and manufacturing plants on Pacific Coast. Desire connection with salary or charge of shop on percentage basis. Age 32. Married. Address, "Welder", 3747 W. 60th St., Los Angeles, Cal.

Experienced Welder and Auto Mechanic—All around experience, capable of handling all work. Age 30. Married. Box 449, The Welding Engineer.

Combination Welder—5 years' experience gas and arc welding steel tanks, pipe, structural and pressure vessels; brazing cast iron, etc. Know carbon arc welding on steel castings, heavy riser cutting, etc. Age 29. Married. Willing to travel. Address Box 450, The Welding Engineer.

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Aggressive man experienced in advertising and promoting welding schools, possessing a successful record of business creation at minimum cost, seeks opportunity. Employed in sales and advertising capacity by outstanding school at present. Your reply is solicited. Address Box 448, The Welding Engineer.

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CROWN BOILER FIX is a metallic powder with an aluminum base and is used by thousands of master plumbers and welding shops for repairing steam and hot-water boilers. Does not discolor the water.

The unusual and superior feature is that after being poured into boiler and repair is completed the compound never becomes harder than tar, thereby overcoming the most severe trouble encountered in boiler repair, that of expansion and contraction, as Crown Boiler Fix, acting like tar, will expand and contract under all adverse conditions. After electric welding a boiler, a can of Crown Boiler Fix will make the weld absolutely water-tight and will permanently repair all cracks that are impossible for the welder to reach.

Price, $8 per can, less 50% and 10%. One can free with every six.

CROWN RADIATOR FIX is a metallic powder which repairs cracked water jackets, motorheads, leaky radiators, etc.

CROWN RADIATOR FIX MAKES ELECTRIC WELDS ON CAST IRON PERMANENTLY WATER-TIGHT.

Immediately after being poured in radiator, the compound circulates through the entire water system and starts to work.

As the water leaks through the cracks and porous parts, it carries with it the Crown Radiator Fix, which, instantly upon coming into contact with the air, congeals and forms a permanent metallic repair.

Price, $12 per doz., less 50%. Prices on larger quantities on application.

CROWN ALL-METAL FILLER is a mineral composition that repairs cracked water jackets, motorheads, porous castings, etc. Heat part to be repaired to 300° heat and rub on filler which penetrates the cracks and pin holes and hardens almost immediately.

SPECIAL FOR ELECTRIC WELDERS

Crown All-Metal Filler is the only compound that will make an electric weld on cast iron absolutely watertight. It penetrates through the smallest pin-hole where it is possible for water to leak out, and the filler will rust, which is necessary for a permanent repair.

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On extreme porous welds, apply All-Metal Filler on outside and Crown Radiator Fix on the inside. In the event that a hair crack is overlooked or develops after making the weld, this double seal process will positively make the job water-tight.

Standard size pound box, $4.50.

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Competitive tests prove that the Smith-Waters Welder can save as much as 50% in welding operating costs. The stable arc assures constant deposition of weld metal. No moving parts. This machine is unconditionally guaranteed for two years.

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